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AMERICAN ANTIQUITY

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GEOLOGIC-CLIMATIC DATING IN THE WEST

ERNST ANTEVS

GEOLOGIC-CLIMATIC dating of archaeological finds in the arid and semiarid western United States is based on geology, on the relationship between moisture, vegetation, and geological processes, and on climatic history. The procedure of dating includes 4 main steps, namely, (1) study of beds and geological features, (2) climatic interpretation of beds and features, (3) assignment of the bed with the human record to a particular regional climatic age or phase, and (4) correlation of the regional relative chronology with a dated climatic history. The geological study of the site includes texture, structure, and appearance of the beds or terrace deposits, their modes and conditions of formation, their sequence, fossils, and artifacts, the soil zones, caliche incrustations, and erosions. The climatic interpretation of the beds and features is made in conformity with the delicate regional relationship between climatic conditions and changes and geological processes and deposits. The regional correlation is carried out with consideration of the areal extent of the moisture conditions and of the climatic history of the region as recorded by fluctuations of lakes, by deposition, erosion, and soil formation in stream valleys, by variation of glaciers, by wind erosion and stabilization of dunes, and by calichification. Correlation with a dated climatic history, that is with the Finno-Swedish and North American varve chronologies, is made by means of the major temperature ages and changes. The transatlantic correlation is carried out on the strength of the parallelism and similarity of the past temperature histories of North America and Europe and on the agreement of the temperature rise which has occurred in both continents during the last century or two.

The present study is concerned mainly with the general problems of dating in the west, such as the relationship between moisture, vegetation, and geological processes and deposits, means, bases, and ranges of correlation, geochronology and temperature history, climate of the last glacio-pluvial, the fluctuating decline of pluvial conditions, the Long Drought including its beginning and ending dates, and the moisture fluctuations during the Medithermal and their dates.

The major time division is based on long-continued temperature conditions and changes for telecorrelation, but the regional time division is founded on the moisture conditions and changes, because it is these which determine the geological processes and thereby enable regional correlation.

The absolute chronology employed is based mainly on postglacial and glacial clay varves (annual deposits). The North American late-glacial chronology is connected with the Finno-Swedish late-glacial and postglacial chronology by correlation of the Cochrane stage with the Salpausselkä stage. Radiocarbon dates are used for details whenever available and pertinent and deemed satisfactory. The salt contents of Abert, Summer, and Owens lakes date the end of the Altithermal Long Drought. Within the Christian era treering dates of droughts have been helpful in assigning arroyo erosions.

RELATIONSHIP BETWEEN MOISTURE, VEGETATION, AND GEOLOGICAL PROCESSES AND DEPOSITS IN VALLEYS OF NONGLACIAL STREAMS

The character of the geological activity of streams varies with the moisture conditions. A dividing line is located between subhumid and semiarid climates. In regions where the climate has fluctuated between semiarid and arid, the relationship between moisture and geological processes has also differed in the upper and in the middle reaches of the streams. The various relevant relationships are shown in Table 12.

The western plateaus, plains, basins, and valleys which are now semiarid (Thornthwaite 1948, Pl. 1) were during the last glacio-pluvial for the most part subhumid (Antevs 1954a: 189). In this subhumid climate the streams which rose in the foothills and on the plains may have enlarged their channels, because they had large volume, and because the runoff contained relatively little detritus owing to the ample vegetation.

Such rivulets — not glacial streams — fed the pluvial lakes of the Southwest and brought mostly clay. In southeastern Arizona, Greenbush Creek at the time of the mammoth hunt at Naco and Whitewater Draw when the Cochise people camped at Double Adobe were brooks of this kind.

When the climate turned semiarid, the ground cover became less dense and the stream flow decreased. As a consequence the rivulets became incompetent to transport the increased debris load, so that part of it remained in the channels.

In semiarid to arid regions erosion, deposition, and inactivity of streams are controlled by the state of the vegetation and of the associated plant litter and soil mantle, which are determined by the moisture conditions. When vegetation, litter, and soil are healthy and ample, the waters of rains, even exceptional ones, are so effectively retarded and absorbed that the runoff causes little or no erosion. On the other hand, when the plant cover has become impaired or poor by drought, overgrazing, or other destruction, the waters of heavy showers race unhindered down the slopes to form raging torrents which cut channels in stream beds and valley floors (Antevs 1952c: 377). Materials dislodged by small to moderate floods are in part temporarily deposited in the existing channels, especially if these are very long. These and other materials are by occasional flash floods swept below the terminus of the arroyo and dropped as the water spreads, sinks into the ground, and evaporates. Big flash floods have extraordinary eroding and transporting power because their flow is confined between the arroyo walls.

When the moisture conditions are transitional or intermediate and as a consequence the vegetation is sparse on uplands and fair to good in valleys, the rain waters pick up debris on the uplands and drop it among the growth in arroyos and on valley floors.

Since under natural conditions the vegetation in these dry climates is about proportionate to the moisture, quiescence with soil formation prevails during the relatively moist semiarid ages, channeling during dry ages, and deposition during climatic transitions (Table 12). Old natural arroyos, which are known by cross sections exposed in the walls of modern channels, were thus caused by prolonged, killing droughts or dry ages (Bryan 1928: 281).

Modern arroyos, however, must have a different cause, for in areas protected from livestock the native, original vegetation has not been drought-killed but is still present. The existing channels, which have been formed mainly since A.D. 1880, are artificial, being results of overgrazing and human activities (Antevs 1952c). These channels, arroyos, have vertical walls and flat floors and are of all sizes up to 100 feet deep, many hundreds of feet wide, and 140 miles long. They were cut at an incredible rate until channels were formed which could accommodate the big floods. Arroyos are characteristic of the upper reaches of streams somewhat below the headwaters.

The floors of modern arroyos here and there have small basins. Those in fairly impervious beds may hold water for weeks after an arroyo run and serve as watering holes for wildlife and cattle. Such tanks were called "charcos" by Bryan. When the muddy water disappears by evaporation and slow absorption, a clay film is deposited. Old charco clays, exposed in modern arroyo walls, have been found to contain artifacts, broken animal bones, and charcoal left by paleo-Indians who camped by the tanks (Sayles and Antevs 1941: 52, 53, Pl. 8).

TABLE 12. RELATIONSHIP OF MOISTURE, VEGETATION, AND GEOLOGICAL PROCESSES IN VALLEYS OF NONGLACIAL STREAMS

Climate: Phases and Fluctuations	*Plant Cover*	*Process in Upper Reaches of Streams*	*Process in Middle Reaches*
Subhumid	Ample	Streams relatively clear; erosion of stream valleys, soil formation where no erosion	Erosion
Changing from subhumid to semiarid	Good	Filling of stream channels, followed by soil formation on fill	Deposition
Semiarid	Good	Neither appreciable erosion nor deposition; soil formation	Entrenchment; soil formation
Changing from semiarid to arid	Sparse to fair on uplands; fair to good in valleys	Deposition	Deposition; soil formation
Arid upon change from semiarid	Impaired or poor	Accelerated erosion, arroyo cutting, locally leaving coarse residue; local deposition of fine charco clay	Deposition, main
Changing from arid to semiarid	Sparse to fair on uplands; fair to good in valleys	Arroyo filling	Deposition; soil formation

The floor of old arroyos is frequently overlaid by a bed of pebbly, cobbly, or bouldery gravel. These gravels are residues, being left in the channel during its cutting. In places these coarse beds contain artifacts (Sayles and Antevs 1941: 54, Pl. 12 *B*). Charco clays and gravel beds consequently derive from the same dry age as do the channels in which they occur. Most of those that are preserved must date from the last parts of the droughts.

The bulk of the arroyo and valley fills consists of silt, clay, sand, fine gravel, and soil, mixed in various proportions (Antevs 1952c: 380-1). Most deposits are well bedded and some are laminated. They were formed largely during the moisture transitions. They contain artifacts in places (Sayles and Antevs 1941: 49, 51, Pl. 5).

Some beds have been changed by soil-forming processes. These humus-stained zones and soils postulate vegetation and near absence of accumulation and erosion. They imply good to ample vegetation on uplands as well as in valleys and usually record moist ages (Antevs 1952c: 381). Also in the middle-stream sections and below the termini of the arroyos are deposition and erosion largely controlled by the vegetation on the upper reaches and on the uplands, but the relationship is largely reversed (Table 12). Here aggradation of the stream bed takes place mainly during dry-age upstream arroyo cutting, because the large debris masses then transported by big arroyo runs are dropped as the water volume and the stream grade decrease. Stream entrenchment takes place during relatively moist ages, when the plant cover is good on the upper reaches and as a consequence the water volume in the middle sections is large and the water relatively clear. A possible result is stream terraces. A good example of a relevant middle stream section is the Texas Colorado River near Austin, whose terraces contain artifacts (Kelley 1947). The fans below arroyo channels in Arizona and New Mexico have not yielded any records of man.

Glacial Stream Terraces

Streams heading in glaciers and in regions with strong frost action seem to develop terraces at the same time (Moss 1951: 75). The relationship of climate to deposition and erosion by such streams is inadequately known. Bryan and his pupils (Bryan and Ray 1940: 38; Moss 1951: 67) hold that such streams are heavily loaded during glacial advance and contemporary intensive frost action and thus build up their valleys during agglaciation. And they argue that the streams are underloaded and therefore dissect the valley floors during deglaciation because then the volume of meltwater is larger and the detritus available is less due to weaker frost action. One valley-train terrace is thus believed to form during each stadial ice advance-retreat. In support of this reasoning and conclusion they show that several valley-train terraces extend to, but not beyond, certain end moraines.

Other geologists (Cotton 1942: 329-30; von Engeln 1942: 236) believe that, on the whole, glacial streams remain heavily loaded and aggrade their valleys as long as glacial erosion takes place in the cirques, and that they begin to trench the valley floors first after the glaciers have disappeared.

It appears that only climatic oscillations of very considerable magnitude and duration can produce these terraces, and that trenching may begin well before the glaciers are gone. The linear extent of the valley sections affected by deposition and dissection naturally varies with the size of the glaciers and the quantities of the released water and detritus.

Means, Bases, and Ranges of Correlation

During all stages of the dating procedure there is need for correlation: correlation of beds, features, or climatic history. Fossils permit rough correlation and serve primarily to distinguish the old from the young. Extinct mammals may indicate pre-mid-Altithermal age, for only modern mammal remains have been found in beds which are surely mid-Altithermal or younger (Hunt 1953: 19). The order and actual dates of extinction are little known. Mollusks are hepful by indicating certain climatic conditions and so suggesting age. Sloth dung associated with artifacts in Gypsum Cave, southern Nevada, contains remains of a plant assembly which is now found only at 3000 feet higher elevation or above and thus indicates pluvial age (Laudermilk and Munz 1934). The presence of hickory charcoal in the lowest artifact-bearing bed at Double Adobe in southeastern Arizona proves its pluvial age, for hickories do not now grow closer than eastern Texas (identification by L. H. Daugherty in Sayles and Antevs 1941: 47, 68).

Characteristic artifacts help to correlate unsimilar beds, and, if their age is approximately known, they at the same time roughly date beds and other artifacts.

Stream terraces can be correlated by order and relative altitude. Within the same valley,

beds may be recognized by appearance and similar mode of formation. Deposits of permanent ponds, dammed by man or beaver, in most cases suggest pluvial age. Soil zones may be recognizable by stratigraphic position and by development. A distinct caliche zone marks the Altithermal Long Drought (see below). Large old dune fields may also indicate the Long Drought. Old filled arroyo channels, exposed in the walls of modern arroyos, record droughts and are distinct markers.

The actual basis for correlation of these beds and features are the climatic conditions which caused their formation. The climatic factors were discussed in the preceding sections and in Table 12. Correlation is evidently limited to the region in which the factors had the same or equivalent effects simultaneously. A caliche zone in Arizona may be correlated with the desiccation of lakes in Oregon, but arroyo cutting, which is limited to the upper reaches of streams, cannot be correlated with the trenching of the middle section of the same or an adjacent stream.

As regards geographic ranges, pluvial climate is known from Oregon and Idaho into Old Mexico and southeastward to east Texas, to the Patschke Bog, located 40 miles east of Austin, and to the Gause Bog in Milam County to the north of the Patschke. The Altithermal so-called Long Drought of about 5500 to 2000 B.C. is according to several observers recorded by maxima of grass-chenopod-composite pollens, low lake levels, wind erosion, dunes, arroyo cutting, and calichification in practically the same area (see below). It was probably present in Iowa (see Antevs 1950: 45, 47). It has been distinguished in Ohio, Connecticut, and other states as the xerothermic maximum (Sears 1948: 330-1; Deevey 1949: 1385). The Long Drought probably prevailed in central and eastern Texas, for the proportions of the warm-moist and of the warm-dry strata in the Patschke and the Gause bogs suggest that the upper 5 feet of the dry-climate peat in the Patschke Bog may only be a remnant of the bed formed since the beginning of the

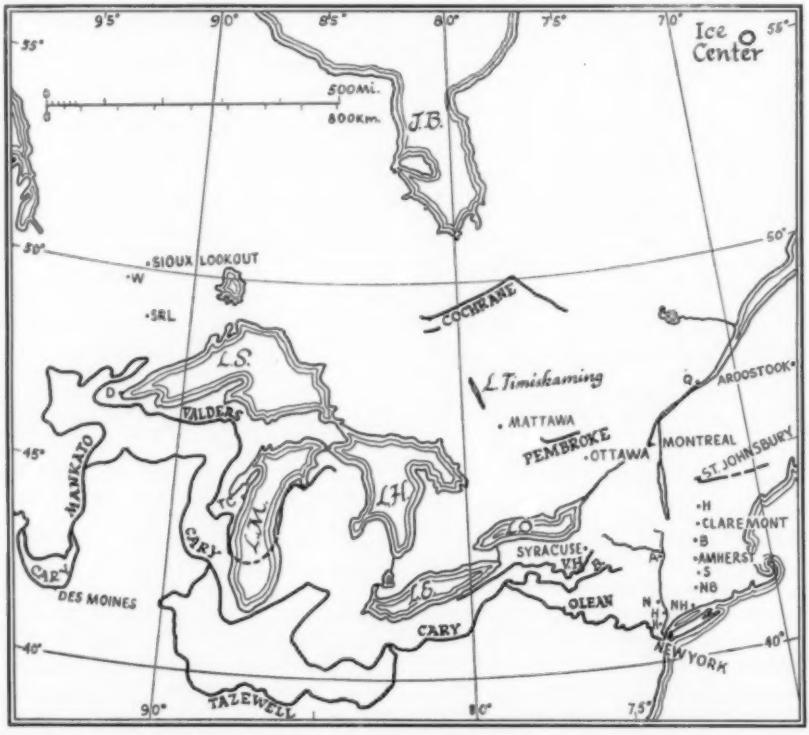

FIG. 88. Northeastern North America, showing localities and moraines; moraines mainly from Leverett, MacClintock, and Apfel. (From Antevs 1953: 205. Reproduced with permission of the Univ. of Chicago Press.)

Long Drought, a considerable part being lost through fire in prehistoric time (Potzger and Tharp 1947, 1954; Antevs 1950: 45a, 49).

However, it is debatable whether or not the little-known moisture history of eastern and central Texas agrees in all respects with that of New Mexico. While the peat columns can be incomplete, especially the fact that the chestnut, which disappeared near the tops of the Patschke and Gause bogs, now grows first 100 miles to the east of the Patschke, where the precipitation is some 5 inches heavier, suggests relatively dry climates during the late Medithermal and the present. In the Abilene region of central Texas (Leighton 1936; Wormington 1949: 118-22) there are important regional features which do not conform with those in New Mexico, namely the well-developed soil on the Durst silt, the relatively small subsequent erosion, the huge quantities of the Elm Creek silts, and the large entrenched-stream valley. Further study is needed to solve these problems.

The drought of A.D. 1276-1299, probably the severest one since the Long Drought, is known by narrow tree-rings and arroyo cutting from west-central Colorado to southeastern Arizona and into Sonora (Douglass 1935: 49, 64; Schulman 1946, Pl. 3; 1947b: 8; Hack 1942: 51-2, 67-8; Sayles and Antevs 1941: 43), in Trans-Pecos Texas (Bryan and Albritton 1943: 486-7), and on the Texas High Plains (Evans and Meade 1945: 499-500). It has not been recognized in Nebraska or Iowa (Antevs 1950: 48). The drought of 1573-1593 is known by small tree growth from western Colorado through New Mexico and Arizona into southern California (Schulman 1946: 45; 1947a: 31, 33), but has not been recognized in arroyo erosion.

Since most sharp modern droughts of the West have extended, in the course of a few years, with varying intensity across the continent (U.S. Weather Bureau 1942), the past droughts perhaps also spanned the continent, but there is no evidence for this.

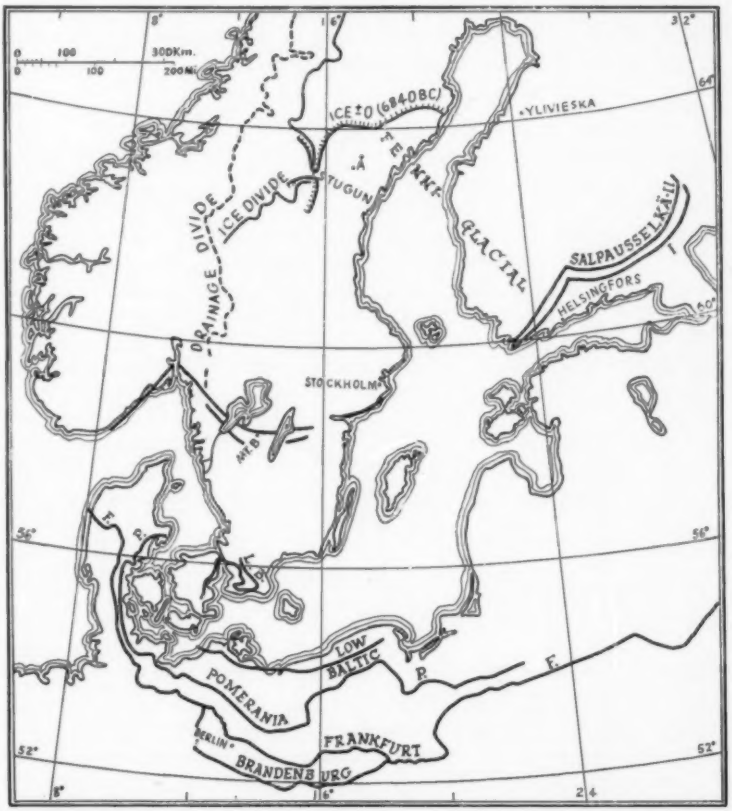

FIG. 89. Baltic Basin, showing localities, moraines, and principal ice divide; moraines mainly from Woldstedt and De Geer; ice divide from Lundqvist. (From Antevs 1953: 198. Reproduced with permission of the Univ. of Chicago Press.)

Correlations based on changes and conditions of moisture have a distinctly limited geographic range. They cannot be made across the Atlantic, for in northern Europe the warmest postglacial age (högvärmetid, Hochwärmezeit) of 5000-3000 B.C. coincided with the Atlantic age (Fries 1951: 121, 126; personal communication), which was moist with high groundwater table and transgressing lakes in comparison to the preceding and following ages, though it was drier than the present (Lundqvist 1949: 368).

Long-distance correlation is feasible only by means of major temperature changes and ages (Antevs 1936). The concurrent temperature rise which has occurred in North America and in Europe since A.D. 1850, or probably since about 1750 (Kincer 1946; Ahlmann 1953: 15, 38; Manley 1951), and the similarity of the deglacial and neothermal temperature histories of the 2 continents, give justification for correlating prominent temperature ages. Thus, the marked Timiskaming and Cochrane stages may be matched with the relatively warm Alleröd and the cold Younger Dryas-Salpausselkä stages (Antevs 1953: 204). Also, the Scandinavian date of about 5500-2000 B.C. may be applied to the warmer age recorded by high percentage of grass-chenopod-composite pollens in Oregon bogs (Hansen 1947: 103-4).

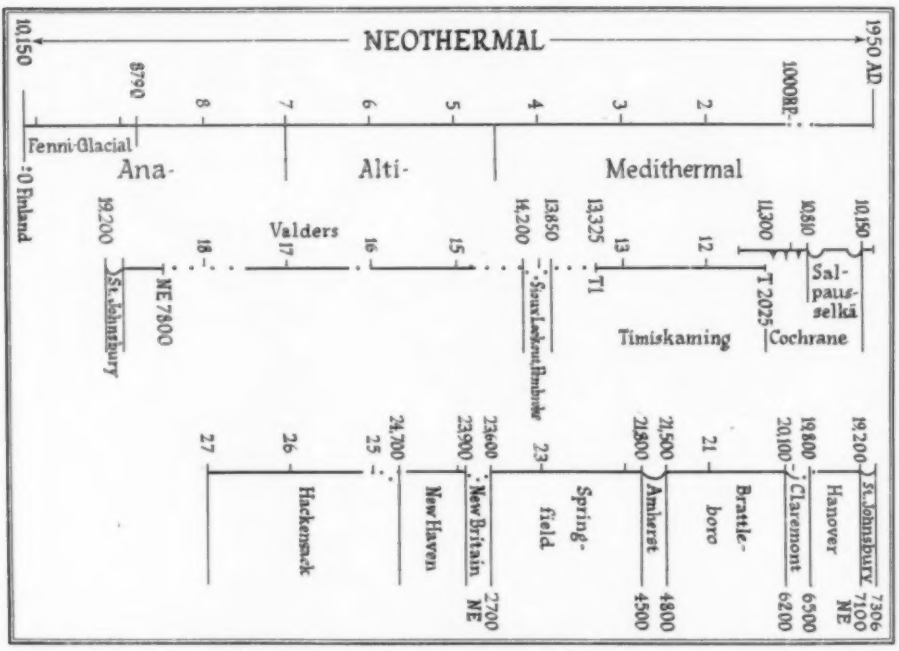

FIG. 90. Graph of the chronology of the Deglacial and the Neothermal. Solid line indicates varve data, dotted line estimates. During the Deglacial, the straight line signifies predominant retreat; bowed line, halt and readvance. If a large late Tazewell ice retreat and subsequent early Cary readvance intervened between the New Haven and the Springfield stages, then the absolute dates of the stages preceding the Springfield retreat were higher than given in the table. For revised division of the Neothermal see Fig. 91. It is now probable that the Valders maximum, recorded by the Manistee moraine in Michigan, was a correlative of the moraine and halt at the northern end of Lake Willoughby, 25 miles north of St. Johnsbury, Vermont, and that the maximum occurred about 18,500 years ago (Antevs 1954b). (From Antevs 1953: 197. Reproduced with permission of the Univ. of Chicago Press.)

GEOCHRONOLOGY AND TEMPERATURE HISTORY

The North American varve chronology ends with the Timiskaming ice retreat and the drainage of glacial Lake Barlow-Ojibway, when the receding border of the last ice sheet for the first time stood between Cochrane and James Bay (Fig. 88). However, the chronology can be connected with the Christian chronology by correlation of its younger part with the older part of the Finno-Swedish varve chronology of the last several millennia.

The postglacial part of the Finno-Swedish varve chronology was worked out by Ragnar Lidén in Angermanland, northern Sweden (see Antevs 1953: 198; present Fig. 89, letter "A"). Lidén measured 7520 consecutive postglacial varves, the oldest of which rested on a glacial varve. Because the varves formed during the last thousand years have not yet been raised above the level of the Baltic, Lidén determined graphically from the rise of land and old maps that the last measured varve was formed some 380 years before A.D. 1300. The postglacial in Angermanland thus began 650 + 380 + 7520 or 8550 years ago, that is, 6600 B.C. Gerard De Geer then correlated glacial varves from beneath Lidén's postglacial varves with glacial varves in an adjacent valley and thus dated the bisection of the ice remnant at Stugun, 450 km. west-northwest of Stockholm, and the resulting megavarve, the Swedish zero year, at 6840 B.C. (8790 B.P.) (De Geer 1940; Ebba De Geer 1954: 299; see Antevs 1953: 199; present Figs. 89, 90).

The chronology of the ice recession in Sweden and Finland has been worked out by De Geer and Matti Sauramo, respectively. Their studies, which complement one another, show that the ice border left Salpausselkä II and its Swedish correlative 1364 years before the Swedish zero year, or 8200 B.C. (10,150 B.P.) (also Ebba De Geer 1954: 299, 309). These moraines form the northern line of the main Fennoscandian moraines which cross the countries south of Stockholm and north of Helsinki (Fig. 89). The 2 lines with intervening retreat represented, according to Sauramo, 660 years and are dated at 8860-8200 B.C. (10,810-10,150 B.P.). The age since the departure of the ice from Salpausselkä II, that is since 8200 B.C., is the Neothermal (Fig. 90).

Broad transatlantic correlation being feasible by means of marked temperature ages of long duration (see above), the Alleröd and the Younger Dryas-Salpausselkä have by me (1953: 201, 204-6; present Fig. 90) been correlated with the warmest part of the Timiskaming retreat and with the late part of the ice border oscillations at Cochrane, Ontario, respectively. The American varve chronology is thus tied in with the Finno-Swedish and Christian chronologies, and the Cochrane oscillations are dated at 11,300-10,150 B.P.

The chronology of the pre-Cochrane ice retreat in North America is fully reviewed with references in a previous paper (Antevs 1953). A graphic summary is given in Figure 90. The principal moraines are shown in Figure 88. The

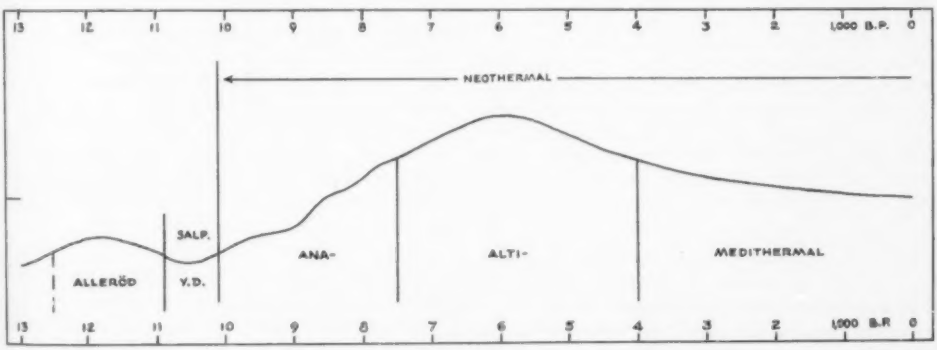

FIG. 91. Temperature graph for the past 13,000 years, deduced by Magnus Fries from the history of the vegetation of southern Sweden. Chronology is the Finno-Swedish varve chronology. (Revised by Fries in February, 1954, from Fries 1951: 126.) Division of the Neothermal is by Antevs; Salp. and Y.D. stand for Salpausselkä and Younger Dryas.

major temperature ages and variations, which form the basis for long-distance correlation, are brought out by separation of the ages of essential retreat from those of predominant halt and readvance. Ages of retreat were comparatively warm, ages of halt and advance relatively cold.

However, the radiocarbon date of 11,400 for the Two Creeks forest bed in Wisconsin (Libby 1952a: 88) together with other radiocarbon dates (C-630, C-800; Libby 1952b: 678; 1954: 139) place the Valders (Mankato) glacial maximum at Milwaukee at about 11,000 B.P. These dates thus correlate the Valders maximum with the Salpausselkä stage. Studying the implications of such a correlation, we find the least objectionable division of time and matching with Europe to be a correlation of the Timiskaming retreat with the Altithermal (Antevs 1954b). This means ignoring the radiocarbon dates bearing on the final drainage of Lake Algonquin when the ice border stood at Mattawa (C-504, C-608; Flint 1953, Pl. 3), which have fantastic implications. One of these inferences is the allotment of 7500 years to the 200-mile retreat of the ice border from the Valders moraine to Mattawa, but of less than 3500 years to the remaining 775 miles of ice recession. Another one is very slow retreat during the warm Altithermal, but extraordinarily rapid recession during the relatively cool Medithermal. The exploratory matching of the Timiskaming retreat with the Altithermal also ignores Quimby's (1954: 326-7) dating of the ice border at Mattawa at about 5500 B.P., which places the Sioux Lookout-Pembroke halt and readvance of the ice border near the middle of the Altithermal. By our trial correlation the Timiskaming retreat, which comprised about 2550 years (Antevs 1953: 197, 207), would be dated at about 4500-7050 B.P., the Cochrane halt at 3350-4500, the Pembroke halt at 7050-7400, and the Valders retreat and maximum at 7400-11,000 B.P.

However, several serious implications make even this, the least objectionable correlation, highly improbable (Antevs 1954b). Correlation of the Valders maximum with the Salpausselkä matches a point at less than ¼ of the distance from the periphery to the center of the North American ice sheet with one at the halfway mark in Europe. The Valders age of retreat, reduced to some 3500 years, is too brief for the history of the Great Lakes. The Canadian ice sheet would have extended to Lake Superior when the Scandinavian ice had entirely disappeared, which it did some 7800 years ago. The ice would still have formed a huge sheet reaching the Timiskaming country, when the temperature in the United States was higher than at present. The post-Cochrane age of some 3350 years is too short considering that the retreatal distance to the Labrador ice center was 575 miles. Besides, this implied rapid retreat of a mile in less than 6 years would have taken place while the glaciers were regenerating and advancing (see below).

All these implications being incredible, the radiocarbon date of some 11,000 years for the Valders maximum must be much too low. On the other hand, my correlation of the Cochrane and the Salpausselkä stages and the dating of the Cochrane at 11,300-10,150 B.P. are directly supported by the facts that, since its release from the ice, the land at the south end of James Bay has risen 600-700 feet relative to sea level (Cooke 1930: 56-8, 67; Flint and others 1945), and that this process required a long time. This postglacial rise of some 650 feet (198 m.), which has taken place in response to the removal of the ice load, equals that of the Scandinavian ice center during the last 8200 years (Gutenberg 1941: 758). Since the uplifts of the central and near-central areas of glaciation in Scandinavia and in North America must have been essentially equal (Gutenberg 1941: 766), that of the James Bay region must have taken several thousand years, perhaps 8000 to 10,000 years. That is, the ice disappeared from the region between Cochrane and James Bay perhaps 8000 to 10,000 years ago. Gutenberg (1954, Table 2) estimates the date at "10,000 ± ? years."

Recently there was published a new temperature graph of the last 13,000 years for southern Sweden (Fries 1951: 123, 126). Brought up to date by Dr. Fries in February, 1954, this graph is shown in our Figure 91. It suggests that, in our simple subdivision of the Neothermal into 3 temperature ages, the distinctly warmer Altithermal should comprise the time 7500-4000 B.P., rather than 7000-4500 B.P. Fries (1951: 127) reports that the Italian botanist A. Chiarugi in 1936 proposed the terms "Anathermal," "Hypsothermal," and "Katathermal" for postglacial subdivisions, that is, before I (1948: 176) suggested corresponding terms.

In northerly regions which were freed from the ice at a relatively late date the warmest age began later. Also, rains being cold, the summer temperature was highest during dry years and ages. Thus, in Labrador a xerothermic age, marked by decomposition of moss peat, heath vegetation, and maximum development of conifer forest, is by correlation with Sweden dated at 2300-600 B.C. (Wenner 1948: 151, 162-5). In southeastern Alaska a similar age, during which conifer forest invaded the muskeg, has, partly on the basis of a radiocarbon date, been assigned to the period from 3000 B.C. to Christ (sample L-106B; Heusser 1953; 1954).

The behavior of glaciers sheds some light on the changes of the summer temperature, and the snowfall, during the Medithermal. In Europe glaciers began distinctly to regenerate perhaps about 500 B.C., and they reached maxima mostly between A.D. 1725 and 1900, after which they have been receding (Ahlmann 1953: 15, 38, 41). Eliot Glacier on Mt. Hood, Oregon, reached a maximum about A.D. 1740

(Lawrence 1950: 215). In coastal British Columbia glaciers attained their greatest postglacial extent about A.D. 1725 and 1860 (Mathews 1951: 357, 378). In southeastern Alaska the glaciers began to expand early in the Christian era judging from a radiocarbon date (L-106C; Lawrence 1953: 84-5, 93); as determined by treering counts, they culminated in the early to middle 1700's (Lawrence 1953: 87). In the Rockies and the San Juan Mountains of Colorado, Richmond (1953, 1954), distinguishes 2 late glacial advances, one probably in the early Medithermal, another from about A.D. 1640 to 1860. He tentatively correlates the earlier expansion with the Cochrane stage. However, date and correlation of this maximum cannot both be right, for the Cochrane is old.

A bottom core from the Pacific Ocean at 9°S. off Peru, dated by W. D. Urry, records the changes in temperature and course of the Peru Current and possibly invasions by other currents (Hough 1953). During the last 65,000 years, which Hough equates with the Wisconsin Glacial and the Postglacial, the core, as interpreted, indicates both agreements and disagreements with the temperature history of the North American continent. Very striking features of the core are the long, 1000 to 8000 years long, warm ages which separate the cold ages I to VI, correlated with the principal Wisconsin maxima in the Midwest. In fact, the time span 65,000-10,000 B.P., the Wisconsin Glacial, contains exactly as many warm as cold years. Equally striking is the fact that, excepting the age 7000-5000 B.P. and brief interludes about A.D. 50 and 850, the last 10,000 years are cold in the core. In other words, the core records high temperatures for long periods during the middle of the Wisconsin, but mainly low temperatures for the deglacial and later ages. Evidently, this core history is not generally applicable to North America, even though certain details agree, as the temperature maximum about 6000 years ago. There seem to be no American records of the 2 very cold (1250 and 850 B.C.) and 2 comparatively warm (A.D. 50 and 850) Medithermal periods which Quimby (1954: 319, 328-9) introduces from the Pacific core.

Last Glacio-pluvial Maximum

It is probable that the vast area from central Oregon and the coast of southern California into Texas, perhaps to the Gulf of Texas, had essentially the same moisture history during the last glacio-pluvial and later ages (see above discussion of correlation).

The precipitation on the Pacific slope and in the Great Basin is now, and was in the past, to a considerable degree controlled by the Pacific anticyclone (Willett 1944: 143-9). In summer, when this is strong and to the north (Lat. 40° N.), it blocks storms, so that rains are scarce. In winter, when it is weaker and located to the south (Lat. 30° N.), cyclonic storms reach the continent and bring rains. Then its actual location and development play a part in determining the latitude of the rain-bringing winter cyclones.

During the glacials the ice sheets in Canada and in the northern states forced the pressure and precipitation belts south of their modern positions. The Pacific anticyclone did not develop to block summerly cyclones, so there may have been summer precipitation. The cold and rainy season was longer. With pressure changes over the Pacific and the continent, such as occur at present every few weeks, different cyclonic storms entered the continent at different latitudes, so that the precipitation was dispersed in the course of the winter from Canada to Mexico. The largest pluvial lakes in the Great Basin centered on Latitude 40° N., 8° south of the present belt of heaviest precipitation, but also southern California may have had its wettest age, when the ice sheet and the climatic belts were farthest south. Reduced evaporation as a consequence of the lower temperature was a very important factor of the greater moisture.

In the Mono basin, California, the last prominent lake and ice maxima appear to have been essentially synchronous (Kesseli 1948; Putnam 1950: 120-1). Still, it seems probable that most of the Great Basin lakes culminated during the early stages of glacial retreat, for they were in part fed by glacial streams, and between A.D. 1857 and 1919 Mono Lake rose 50 feet, while the glaciers in and adjacent to the Mono basin receded (Antevs 1939: 90). The last primary glacial maximum in the western mountains is now correlated with the Cary glacial maximum of the Midwest (Richmond, Morrison, and Bissell 1952). The Cary in turn has been matched with the New Britain, Connecticut, halt or glacial culmination (Antevs 1953: 211-2, 216; Flint 1953: 904, Pl. 2), which is dated by the varve chronology at more than 23,600 years and by the radium method at more than 19,000 years (Urry 1948: 697). The lakes corresponding to this glacial maximum are believed to have been Lake Provo (4800 feet) in Utah and Lahontan II (4370 feet) in Nevada (Fig. 92).

A new study (Antevs 1954a) of the past climate of New Mexico and contiguous regions has arrived at results which differ essentially from earlier views. It shows that the mountain glaciation Wisconsin II (W2) of Ray (1940: 1893-1900), though made up of glaciers only 2 to 6 miles long, was a product of both lower temperature and greater snowfall, and that the latter increased in importance southward. The study also finds that the large pluvial lakes, which are known to have required both heavier precipitation and lower temperature (Antevs 1935: 309; Leopold 1951: 165-6, 399), must have culminated at the same time as the mountain glaciers, for both had the same meteorological requirements. It finally concludes that the precipitation which nourished the lakes and the glaciers was comparable to the abnormal one of November, 1940 to October, 1941.

The study thus removed the 2 old objections to the correlation of the glacial and the pluvial maxima in the Southwest. The first was that the small glaciers appeared to be fully explained by the lower temperature alone. The second objection was the fact that only ⅓ of the annual precipitation of New Mexico comes during the winter half-year, October to March (U.S. Dept. Agriculture 1941: 1017) and the resulting difficulty to understand how the precipitation could have been greater with longer and stronger winters. The abnormal precipitation of November, 1940, to October, 1941, which was 204 percent of the normal for a 12-month period in the state, was produced by an exceptional number of cyclonic storms, caused by some unknown irregularity in the general atmospheric circulation.

Ray's Wisconsin II is now believed by Nelson (1954: 341) and by G. M. Richmond (personal communication) to be mostly a correlative of the Tazewell glacial maximum of the Midwest, while Ray's W3 is held by Nelson to correspond mostly to the Cary maximum. If so, the Cary snow line in New Mexico lay from 100 to a few

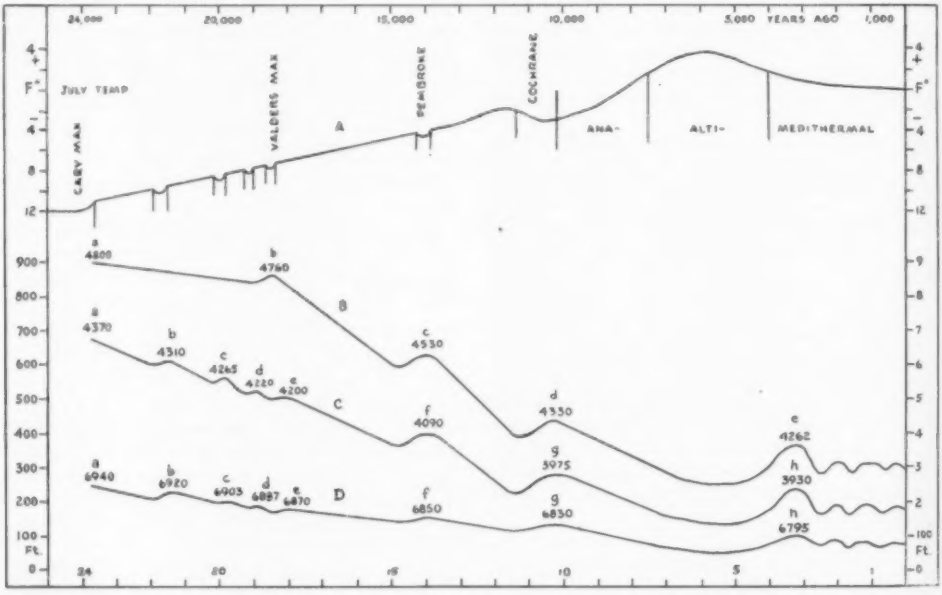

Fig. 92. Tentative graphs of temperature (A) and lake levels (B, C, D) since the Cary-Provo glacio-pluvial maximum, and tentative correlations.

In the *Bonneville Basin*, Utah (graph B), the Provo level *a* and level *b*, together with their correlations, are after Bissell (1952); the Stansbury and Dugway levels *c* and *d* are after Ives (1951: 795); and the Mills Junction beach *e* is after Antevs (1952a: 104).

In the *Lahontan Basin*, Nevada (graph C), levels, *a*, *e*, and *g*, and their correlations, are from Morrison (1952), *h* is from Stanley (1949), and the others are after Antevs. Between levels *a* and *e*, which are Morrison's Lahontan II and III, there was, as the evidence is interpreted by Morrison, a lake recession to the 4050-foot level.

The shorelines in the *San Augustin Basin*, New Mexico (graph D), are after leveling by Powers (1939).

hundred feet higher than that calculated by me for the W2. Also, the temperature lowering was 0.33° to 1°F. smaller. The Cary maximum may have been attained fully 24,000 years ago. The then lowering of the snow line indicates that the June to September temperature in New Mexico and southern Colorado was at most 10°F. (July temperature 12°F.) lower than at present (Fig. 92). With this temperature, the precipitation over pluvial Lake Estancia in the center of New Mexico must have been 23 inches, or 9 inches more than at present, in order to maintain the lake at its highest level. This can be read from a hydrologic graph by Leopold (1951: 163). Lake Estancia was 23 by 35 miles, or 450 square miles, in extent and 150 feet deep (Meinzer 1911: 18). There were many other pluvial lakes, several among them large, in southwestern New Mexico and southeastern Arizona, and on the Texas High Plains (Meinzer 1922; Powers 1939; Evans and Meade 1945). Most of the basins are now dry much of the time.

A good measure of the climatic difference between the glacio-pluvial maximum and the present is furnished by the altitudinal difference between the climatic belts and life zones then and now. On the latitude of Santa Fe the Cary-age snow line stood 4000 feet lower. In the same region the dusky marmot once lived 4000 feet below its modern range (Stearns 1942). This 4000-foot lower altitude of the life and climatic zones means that forests and tall-grass prairies occupied the areas now held by semiarid pinyon-juniper woodlands and short-grass steppes, while these latter types of vegetation dominated the modern arid regions occupied by desert grass and creosote bush (Antevs 1954a: 189).

LATE PLUVIAL MOISTURE FLUCTUATIONS

After the glacio-pluvial maximum, ice sheets, glaciers, and pluvial lakes receded. The prime factor was probably a general temperature rise. This increased the evaporation, and the ice retreat made the belt of heaviest precipitation shift northward. As a result the lake levels continued to drop. The various recessions were interrupted by halts, advances, and rises. Those shorelines which mark long stops in the drop or record limits of temporary rise of the lakes should correlate with prominent moraines recording long halts or advances of ice sheets and glaciers (Fig. 92).

A feature of great importance but little known is the amount of the lake recession during each cycle, before each rise, or the amplitude of the moisture fluctuations. The graphs in Figure 92 are meant only to convey the idea, not to suggest the amounts. The moisture fluctuations during the late stages of the Long Provo Pluvial concern us especially, because these latter furnish most records of early man. The fluctuations recorded by the Patschke Bog, 40 miles east of Austin, Texas, are interesting even though their areal extent is not known (see above). Directly above the bottom bed containing pollens of boreal spruce and fir, maxima of grass and oak pollens indicate a dry age and, 1 to 3 feet higher, a somewhat dry age (Potzger and Tharp 1947; see Antevs 1950: 45a, 49). These droughts might represent the Valders-Mankato and the Timiskaming ice retreats, or more probably the Timiskaming retreat alone. The droughts do not appear in the analysis of the Gause Bog (Potzger and Tharp 1954), perhaps because the samples were spaced too widely.

The sediments of the pluvial lakes on the Texas High Plains, called the Tahoka clay, present in places alternating beds and breaks in the deposition with soil formation and possible erosion, but the lakes seem to have been practically permanent (Evans and Meade 1945: 495; Evans 1949: 11, 14). The correlative San Jon formation at the San Jon site, 38 miles north of Clovis, New Mexico, was to a large part exposed towards the end of deposition of zone 2 permitting deep dry-cracks to form, but the central portions of the pond probably did not go dry (Judson 1953: 15, 20, 24, 26). The San Jon formation shows no other breaks in the general region of San Jon. Thus, as far as known, the sediments of these pluvial lakes do not record any intervals drier than the present.

The lakelet at Clovis Gravel Pit (Blackwater No. 1 locality) requires a special discussion (Evans 1951; Sellards 1952: 28-31, 54-8, 72-4; Antevs 1949). As known through Evans' excavations, 4 separate beds were deposited here in a spring-fed pond. At least bed 3, a diatomaceous earth, was formed in a permanent body of water. The lakelet had the outline of a frying pan, about 700 feet in diameter, with a tapering handle (Evans 1951, Fig. 1). The lowest pluvial-age bed, the speckled or gray sand, is pebbly near the margin. It is the coarsest of the 4 beds and indicates the strongest stream flow. Therefore, the gradual oncoming of the pluvial is not recorded. The depression must have become closed by an artificial dam, built by man or beaver, when the pluvial was well advanced.

The 4 beds are separated by 3 disconformities. The eroding agent must have been either wind or stream. Observations indicate that wind erosion would have required drier climate than now prevails. Thus the several existing basins in the Clovis region (Howard

1935: 80) and in nearby Texas (Evans and Meade 1945: 486-90), which are largely wind eroded, were mostly formed in the past, probably several thousand years ago. The basin at the Clovis Gravel Pit was scooped out by the wind during the Long Drought and was later filled with sand; it remained filled until recently excavated (Evans 1951). While there is some deflation now at the Clovis sites, there is more refilling. All the larger playas on the Texas High Plains examined by Evans and Meade are slowly filling (1945: 489). Therefore, if caused by wind, the erosions of the pond beds would postulate 3 intervals drier than the present, real breaks in the pluvial conditions. Since there are no known comparable old erosions in other pond or lake beds in the region, those in Clovis Gravel Pit are probably not results of dry-climate wind erosion.

If the eroding agent was a stream, then the pond must have been completely drained each time, for the erosions were greater in the center than near the margins of the basin. The dam would have failed 3 times, to be restored after each break. When in existence the dams must have withstood overflow, which dams of unconsolidated debris do not do. Just as the original dam appears to have been artificial and built by man or beaver, so must the restorations.

Consequently, the erosions at the Clovis Gravel Pit may have been done by a stream, and the dam of the pond may have been originally constructed and 3 times rebuilt by man or beaver. At Clovis there is no evidence that any stages during the pluvial were drier than the present.

Long Drought

The best evidence for a long dry and warm mid-Neothermal age is supplied by marked maxima of grass-chenopod-composite pollens in the Chewaucan Marsh and Warner Lake sedimentary columns (Hansen 1947: 103-4; Flint and Deevey 1951: 279), and by Abert and Summer lakes, all in south-central Oregon. Before white settlers diverted the tributaries, Abert and Summer lakes contained only small amounts of salt, quantities which would have accumulated in about 4000 years with the modern stream flow (Van Winkle 1914: 117-23). The lakes of the late 1800's consequently cannot have been residues of the pluvial lake, or lakes, which did not overflow. The basins must have been freshened upon complete desiccation by removal of the salts by wind or by their burial. Therefore the lake basins must have been dry for long ages prior to 2000 B.C. The same explanation was applied by me (1938) to Owens Lake in east-central California whose low salt content had previously been attributed to overflow until 2000 B.C. From these lake records the end of the Long Drought has been set at 4000 B.P. (Antevs 1938; 1948: 178). This date is supported by Fries's temperature graph for reasons stated below (Fig. 91).

Other evidences for a remote and long warm-dry age include complete or essential disappearance of permanent ice in the western mountains (Matthes 1939; 1942: 211-21), prevalent wind erosion and arroyo cutting in the Southwest (Hack 1942: 43, 68; Evans and Meade 1945: 499; Judson 1953: 60), and accumulation of caliche (Bryan and Albritton 1943: 481-2, 487; Bretz and Horberg 1949: 507-10; Leopold and Snyder 1951: 8-9, 15). Further good evidences are the occurrence of artifacts below peat in Lower Klamath Lake, northern California (Antevs 1940; Cressman 1951: 300), and the presence of Cochise II artifacts in silts well below the recently eroded northern part of the swampy San Simon Cienega in the southeastern corner of Arizona.

In the arid and semiarid West, where the potential annual evaporation now exceeds the precipitation by some 2.5 to 8 feet (Meyer 1942: 59, Pl. 10), the moisture conditions are greatly dependent on the evaporation and thus on the temperature. The beginning of the Long Drought has therefore for several years been set at the attainment of the temperature of a distinctly higher level than prevails at present. With Fries's new temperature graph (Fig. 91), the Provo Pluvial-Long Drought boundary should be moved from 7000 B.P. (Antevs 1948: 176, 178) to 7500 B.P.

There are some radiocarbon dates bearing on the beginning and the end of this drought. Those of the 2 lowest sands in Danger Cave near Wendover in northwestern Utah are 11,453 and 11,151 years (C-609 and C-610; Libby 1952a: 86; Jennings 1953: 182-8). The cave floor stands at 4310 feet or about 500 feet below the Provo shoreline (4800 feet), now correlated with the Cary glacial maximum (Bissell 1952); it stands 220 feet below the Stansbury shore (4530 feet), and only 107 feet above the gauge zero of Great Salt Lake (4203 feet). The dates therefore imply that only a small remnant of the huge Lake Provo and 18 percent of its vertical drop remained 11,500 to 11,000 years ago, and that the Long Drought began some 9000 B.P.

In contrast stands the radiocarbon date of 6453 years for the explosion and collapse which changed Mt. Mazama into the caldera holding Crater Lake (C-247; Libby 1952a: 86). Mt. Mazama pumice is present in the basin of modern Summer Lake in south-central Oregon.

A concentration of pumice between 4260 and 4280 feet, that is 110 to 130 feet above the modern lake (about 4150 feet) gives the approximate lake level at the time of the eruption (Allison 1954). At 75 feet above Summer Lake the main pumice bed in the old lake deposits is overlaid by 6 feet of stratified sediments which were laid down in water without a break. Therefore, for probably several hundred years after the pumice fall, the water surface must continuously have stood at least some 85 feet above the present lake. By its location Summer Lake is a good indicator of the regional moisture conditions. The radiocarbon date of 6453 years for the Mt. Mazama eruption implies that the Long Drought began first about 5500 B.P.

Evidently, the deduced dates of 9000 and 5500 for the beginning of the drought cannot both be right. Neither is probable. Considering the altitudes, the radiocarbon dates of 11,453 to 11,151 and 6453 are discordant. The eruption of Mt. Mazama probably antedated the emergence and occupancy of Danger Cave.

Radiocarbon dates from the Humboldt Lake region, Nevada, seem to bear on the driest part of the Long Drought, not on its boundaries. They are 7038 years (C-298) for atlatl foreshafts from somewhat below the top of the bat guano in Leonard Rockshelter, 12 miles south of Lovelock; 6004 years (C-278) for bat dung from the top of a guano bed in Lovelock Cave, 15 miles south of Lovelock; and 4448 years (C-277) for the bottom part of a later guano bed in Lovelock Cave (Heizer 1951: 95-7; Libby 1952a: 85-6). During the age 6000-4500 B.P. the bats abandoned the region, presumably because the food supply was inadequate on account of the drought. However, since they returned in force some 500 years before the drought was over, they may have left first long after it began. The date of 5737 years (C-554) for a burned basket with an infant in the lower 4 inches of Altithermal eolian dust in Leonard Rockshelter is inadmissible as evidence for the beginning of the drought, because the burial basket does not mark the then surface of the windlaid material which could have been much higher.

A few radiocarbon dates bear on the boundary between the Long Drought and the relatively moist Medithermal. Samples C-170 and C-571 from Bat Cave in west-central New Mexico were both taken by Herbert Dick in the bed attributed by me to the very beginning of the moister age. The dates are 2862 and 5605 years (Libby 1952a: 83). Differing 2743 years, and widely disagreeing with the approximate probable date, both are clearly incorrect and useless. Samples C-515 (4006 years) and C-556 (4508 years) of Cochise II stage derive from a charco clay, deposited in a depression in the arroyo floor, and from a fine-textured channel fill well above the base, respectively (Libby 1952a: 84-5; Sayles and Antevs 1941: 52). The former suggests that the Long Drought ended after 4000 B.P., the latter that it terminated well before 4500 B.P. The former sample must actually be older than the latter, and both dates are improbable.

Therefore, the Long Drought began about 7500 B.P. according to Fries's temperature graph. It ended 4000 years ago as calculated from the salt content half a century ago of Abert, Summer, and Owens lakes and as estimated from the temperature graph. Some radiocarbon dates bearing on the time of the boundaries of the drought contradict and eliminate each other.

MEDITHERMAL MOISTURE FLUCTUATIONS

Among the evidences that the Altithermal Long Drought was succeeded by a relatively moist and cool age are decrease in frequency of xerothermic plants, accumulation of water in desert basins, development of glaciers in high mountains, stabilization of dunes by vegetation, arroyo filling, and development of wet meadows such as San Simon Cienega. The degree of moisture during the Medithermal varied with time. Some ages were moister, others were drier than the present. The persistence of Abert, Summer, and Owens lakes until deprived by white man of their natural

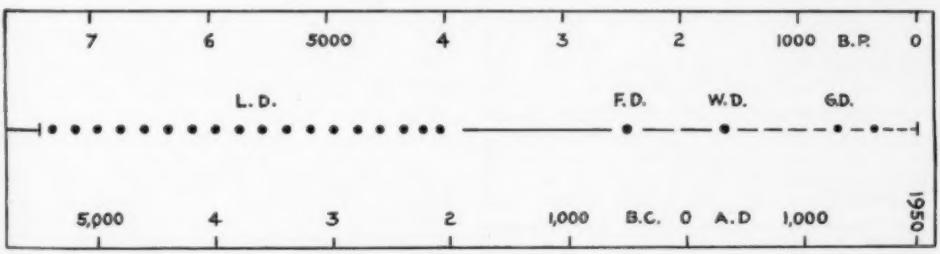

FIG. 93. Droughts (dots) and comparatively moist ages in the West during the Alti- and Medithermal. The decreasing length of the lines suggests the decrease in moisture. L.D. stands for the Long Drought; F.D. for the Fairbank Drought; W.D. for the Whitewater Drought; and G.D. for the Great Drought.

feeders shows that the droughts were not comparable to the Long Drought. The main moisture departures are shown tentatively in Figures 92 and 93.

The droughts will be discussed first.

One drought is recorded at the Cochise III site at Fairbank, Arizona (Sayles and Antevs 1941: 21-3). In this large camp ashes and charcoal accumulated to a thickness of 6 inches, indicating long occupancy during which there was a break in the alluviation. The nearby San Pedro River must have been entrenched and the climate dry. Later the camp was buried by 8 or more feet of silt, sand, and gravel. A radiocarbon determination dates the site and the drought at 2463 years, or at 510 B.C. (C-519; Libby 1952a: 85). I had dated the Cochise III drought at about 1000 B.C. (in Wormington 1949: 90). Features observed by Bryan and his pupils at about the middle of the fill deposited between the Altithermal drought and that of A.D. 1276-1299 are probably correlatives of this drought of 500 B.C. They include an intercalated sand layer, 6 inches thick (Albritton and Bryan 1939: 1434-6), an erosion surface (Hack 1942: 51), and occasional channel erosion and deposition of eolian sand (Judson 1953: 30, 44, 60).

A Cochise III drought is also known by erosion surface Z-1 at Pearce:8:9, 17 miles northwest of Douglas (Sayles and Antevs 1941: 53). According to the radiocarbon age of 1762 years of charcoal from the overlying charco clay, the drought prevailed about A.D. 190 (C-518; Libby 1952a: 84). Interrupted droughts are indicated by narrow treerings in northeastern Arizona A.D. 162-181 and 12-60 (Schulman 1952: 34-5). However, such dates of erosion Z-1 would have implications, for at a nearby site, Pearce:8:8, there are 3 erosions, Z-1, Z-2, and Z-3 (Sayles and Antevs 1941: 43, 45, 54), the last one occurring about A.D. 1300, from which it might be expected that the Z-2 took place at an intermediate date, or about A.D. 600 or 700. This, however, is hardly probable, for erosion Z-2 is overlaid by gravel containing a plain potsherd, and only one other sherd, found by Emil Haury in cienega clay 4 feet below the surface, has ever been observed at any depth in the walls of the Whitewater arroyo, though pottery making was introduced to southern Arizona probably about the time of Christ (Haury 1950: 355). Erosion Z-2 might therefore have occurred early in the Christian era, during one of the ring-recorded droughts of A.D. 320-329 or 257-265 (Douglass 1940; Schulman 1949: 28). Erosion Z-1 might have been contemporaneous with that at Fairbank of 500 B.C., and the radiocarbon date of 1762 is perhaps incorrect.

The best known and probably most severe and extensive drought during the last 4000 years is that of A.D. 1276-1299. It is known by narrow rings and arroyo erosion in most parts of the Southwest. The drought of A.D. 1573-1593, the sharpest since 1300, is so far recognized only by small tree growth from western Colorado into southern California. Though severe, the modern drought would by itself hardly have caused general arroyo cutting, for, where not overgrazed, the native vegetation is still in fair condition (see Antevs 1952c: 384).

During the Medithermal there were sharp droughts probably about 500 B.C. and A.D. 330 and during the years A.D. 1276-1299 and 1573-1593. The droughts need names for easy distinction. The Altithermal drought has for some years been called the "Long Drought." That of A.D. 1276-1299 has long been distinguished as the "Great Drought" (Douglass 1935: 42). The drought and erosion recorded at Fairbank, and dated by radiocarbon at 500 B.C., may be called the "Fairbank Drought." The Z-2 drought of perhaps A.D. 330 in the Sulphur Spring Valley may be called the "Whitewater Drought."

Other ages were moister than the present. The highest Medithermal stands attained by Summer, Pyramid, and Great Salt lakes in the Great Basin seem to have been 40, 63, and 59 feet above their modern levels (Allison 1954; Stanley 1949; Antevs 1952a: 104; present Fig. 92). Lake San Augustin in west-central New Mexico reached 20 feet above its floor, now dry. Since these heights are very moderate in comparison to those during the Provo Pluvial, the climate has been only slightly moister than at present during any part of the Medithermal, that is actually during the last 9000 years (Fig. 92).

In southeastern Arizona stiff cienega clay (or locally, laminated clay), gritty cienega clay, and the faintly laminated top silt indicate 3 phases of decreasing moisture, all 3 moister than the present (Sayles and Antevs 1941: 35-6, 43-5). According to these criteria the moisture was greatest during the first third of the Medithermal, and, between the droughts, it decreased progressively towards the present (Sayles and Antevs 1941: 22, 49, 52-4). In northeastern Arizona the first millennium A.D. was moister than the present, for dunes now active were then stabilized and were used for building sites by early pueblo peoples (Hack 1942: 42-4).

Summary

Geologic-climatic dating in the arid and semiarid West consists in attributing the bed with the human record to a particular climatic age or phase that is at least roughly dated. The method uses geology and fossils, the dependence of geological processes, deposits, and features on conditions and changes of moisture,

and the climatic history. The regional climatic history (undated) has been deduced by many students from fluctuations, disappearance, and rebirth of glaciers and lakes, wind erosion and stabilization of dunes, stream deposition and erosion, changes in vegetation, calichification, and soil formation. This history is dated mainly by the Finno-Swedish and North American varve chronologies after telecorrelation of major temperature phases. The end of the Long Drought has been dated by means of the salt contents in historic time of Abert, Summer, and Owens lakes. Events are dated by radiocarbon determinations made by Libby and by treering records presented by Douglass and Schulman.

The field study usually includes all exposed local and regional beds and geological features bearing on the climatic history. New means are needed to determine the relationship and ages in some cases. On the other hand, gained experiences frequently make it possible to take certain shortcuts, quickly to assign a site or bed, or to estimate its proximate age. Thus the remains of extinct mammals indicate pre-mid-Altithermal age, and a strongly developed Neothermal caliche zone records the Long Drought.

The broad time division has been based on major temperature conditions and changes to enable long-distance correlation and application of dates from other regions. Thus, the Swedish date for the Altithermal has been applied to the abundantly recorded Long Drought on the ground that moisture conditions in our region are greatly dependent on temperature, since the potential evaporation exceeds the precipitation by 2.5 to 8 feet. Also minor temperature changes must affect the moisture conditions, but both changes and relationships are little known.

The subordinate regional time division has been based on the moisture conditions and changes, because these directly determine the geological processes and thus enable regional correlation of geological deposits and features. The moisture variations during the late part of the Provo Pluvial are little known, but as far as the observations go, no stage was drier than the present. Therefore, the erosions at Clovis Gravel Pit may have been caused by stream action after failure of a dam built by man or beaver. At the end of the pluvial there was in large areas a transition from subhumid to semiarid climate, an accompanying reduction of the vegetal cover, and a consequent change from erosion to deposition by the streams.

The postpluvial dry-climate factors have been cyclic. The cycle begins with a drought which reduces the plant mat and soil mantle, so that the waters of occasional heavy rains run off as from a roof, collect into torrents, and trench the valleys. Coarse material is locally left on the arroyo bottom, and fine clays are deposited in depressions (charcos) in the floors. Such residues and charco clays from the late parts of a drought may be preserved, and yield artifacts. As the climate changes from arid to semiarid, the plant cover becomes denser, especially in the valleys. The vegetation retards the stream flow, and the arroyos begin to fill with silt, sand, and clay. Gradually a stage is reached during which the vegetation is good on uplands as well as in the valleys, and then there is neither appreciable erosion nor deposition in the valleys. This is the main age of soil formation which ends the cycle.

However, the number, age, duration, and geographic range of such cycles are still inadequately known. The Altithermal Long Drought erosion, the early Medithermal channel filling, and the subsequent soil formation have been recognized by various students throughout the Southwest. But it has not been obvious whether the cycle ended some time before or after Christ or A.D. 1275. In southeastern Arizona at least it terminated at 500 B.C. The cycle beginning A.D. 1276 probably still prevails.

Since the discovery of a new drought that is geologically effective divides a cycle, it is at present best to emphasize the droughts. Also, droughts are archaeologically most important, because the principal sites occur in their deposits (residues and charco clays), while mostly but solitary artifacts occur in the silts of the transitions. The main droughts have been named to facilitate their distinction. Although knowledge of the relationship between moisture and geological processes and features and of the climatic history are strictly prerequisites for dating, actually most data and theories have been collected and worked out concurrently with the attempts at dating. Most work has been done during the past 20 years by the late Kirk Bryan and his pupils and by me.

Both data and theories are in need of additions and improvements. Particularly wanted are data on the moisture fluctuations during the decline of the pluvial, and more and better means to correlate droughts and cycles.

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FOSSIL BISON AND ASSOCIATED ARTIFACTS FROM MILNESAND, NEW MEXICO

E. H. SELLARDS

SEVERAL EARLY man hunting sites have been discovered and excavated by various institutions in and near the High Plains region of Texas and New Mexico, including the Folsom, San Jon, and Clovis, or Blackwater Draw, localities in New Mexico, and the Miami, Plainview, Lipscomb, and Lubbock localities in Texas. To the west and north are similar sites in Arizona, Colorado, Nebraska, Wyoming, Montana, and the Dakotas. This large region, including a part of the great interior plains, was indeed for early man a big game hunting area of the North American continent.

A new hunting site in this region, located in the southern part of Roosevelt County near Milnesand, New Mexico, about 40 miles south of Portales, is here described. This locality, containing artifacts, a bison-bone bed and charred bison bones, is in a sand-dune region about 3 miles northeast of Milnesand post office. (The name *Milnesand* is derived from "mill in the sand," a term formerly applied to a windmill and watering place located near the present town.) The first artifacts obtained from the locality were collected by Ted Williamson of Milnesand. Notice of the occurrence of artifacts and charred bison bone at this place was given to the Texas Memorial Museum by Oscar Shay of Portales. In March, 1953, the locality was visited by a party consisting of E. H. Sellards and Glen L. Evans of the Texas Memorial Museum, and Oscar Shay, Jerry Ainsworth, and Jim Warnica of Portales. A sample of the charred bison bone and a few artifacts were collected at that time. Among the artifacts was a projectile point, number 2 of the collection, found in place in the bone bed by Ainsworth and very generously presented by him to the Texas Memorial Museum. The locality was again visited by Shay in June, 1953. Two projectile points obtained in place at that time were also very generously presented to the Museum. These 2 points are numbers 9 and 10 of the points here described.

A later study of the locality, including collections of artifacts and fossils, was made during August and September, 1953, by a Texas Memorial Museum party consisting of Sellards, Shay, Ainsworth, and Holmes Semken. Special indebtedness is acknowledged to the ranch operator, Ted Williamson, who also participated in collecting artifacts. Thanks are due also to the owners and operators of the nearby Ainsworth ranches for many courtesies extended during the time the excavations were being made. The illustrations have been made by Hal Story.

Topographic Location. The locality is within about 25 miles of the west margin of the High Plains and 10 miles or thereabouts from the Texas border. The tract of land including the site was at one time a cultivated field. As a result of cultivation the sand has shifted in recent years, forming small dunes and blowouts scattered irregularly over the area. Aside

FIG. 94. The Milnesand locality. In the foreground is the bison-bone bed as exposed by wind erosion. Wooden stakes indicate location of artifacts among the bones.

FIG. 95. A part of the bone bed from which overburden has been removed by excavating.

from the sand dunes and blowouts, the land is nearly level and the original drainage pattern is not now easily made out. However, the regional slope is eastward, and the site, previous to formation of dunes, was probably within a broad, shallow, northeastward-trending drainage way. At present the rainfall is largely absorbed by the sand dunes and sandy soils, except some ponding of water in blowouts.

The Geologic Conditions. The oldest formation available for examination at this locality is an indurated caliche common to this region, forming a cap rock overlying plains deposits of undetermined age. The caliche was reached by test pit (Fig. 97) and was dug into about 2 feet. Next above the caliche is a stratum of reddish brown sand about 2 feet thick with sufficient clay constituent to be sticky when wet. A bison-bone bed, varying in thickness from 2 to 5 inches, lies within and on this clayey sand. The bone bed, except where exposed or removed in the blowout, is overlain by 1 to 4 feet of yellow sand (Fig. 96).

The brown sand in and on which the bone bed rests was deposited, as indicated by the clay ingredient, either under water or at least under conditions of considerable moisture. No pond snails were found in the deposit, which may mean that the water was not sufficiently permanent to afford suitable habitat for snails. There is no evidence at the present time of the place having had a salt encrustation such as might have attracted bison. The most likely condition of accumulation of the bone bed is seemingly a wide, shallow depression providing at least a temporary watering place for bison. Under moister conditions than at present, the plant growth bordering such a depression may well have been sufficient to afford hiding places for the Indian hunters.

The Bison-bone Bed. This lies partly exposed in a blowout formed since the field was abandoned as cultivated land. In the course of excavating it was found that the bone bed extended to the southwest somewhat beyond the limits of the present blowout and within this area of about 400 square feet retained an undisturbed overburden of from a few inches to about 4 feet. The artifacts found in place in the bone bed within this area were as follows: numbers 12, 13, 14, 15, 17, and 19 (Fig. 97 *A*). For study and exhibit purposes, 5 blocks of bones were taken from this area. Four of these blocks contain one artifact each. numbers 12, 13, 14 and 15, which have been retained in place among the bones.

Adjacent to this area of undisturbed overburden was an area of approximately equal extent where the bone bed had recently been uncovered or nearly so by wind erosion (Fig. 97 *B*). The artifacts of this area, including numbers 2, 3, 9, 10, 11, 16, 18, and 26, had not

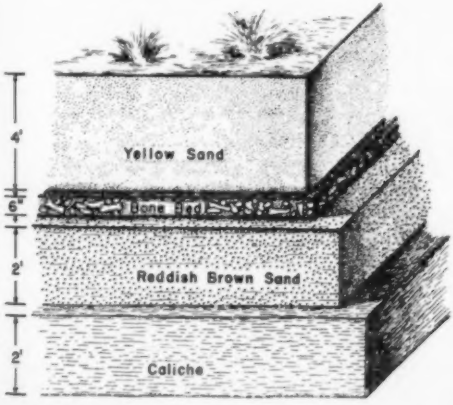

FIG. 96. Geologic section at the Milnesand locality.

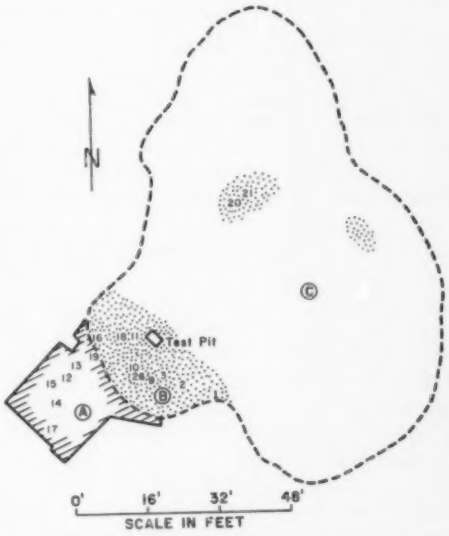

FIG. 97. Sketch of sand dune blowout. A, extension of bone bed to the southwest of the blowout, in which overburden has been removed from the bone bed; B, area of the bone bed exposed by wind erosion; C, the remainder of the blowout; 1, location of hearth; other numbers show locations of artifacts.

been fully uncovered or dislodged from their original position in the bone bed. The location of the hearth containing the charred bison bones is indicated by the entry 1 in Figure 97. The charred bones were at the margin of the blowout and may be a little higher in the section and hence somewhat later in time than the bone bed.

Next, to the northeast, including the greater part of the blowout, was a much larger area in which the bone bed apparently was formerly present but is now represented only by fragments of bones lying on or partly in the clayey sand of the blowout (Fig. 97 C). Artifacts collected on the surface in this area, including numbers 4, 5, 27 to 34 inclusive, 39, and 40, are thought to be largely if not entirely residual from the disintegrated bone bed. Northeast of the center of the blowout are 2 isolated remnants of the bone bed, in the larger of which 2 artifacts were found in place, numbers 20 and 21. The presence of these remnant areas suggests that other areas of the bone bed may occur farther to the northeast. The bone bed in these areas lies at a slightly lower elevation than in the southwestern part of the exposure. These observations lead to the conclusion that the bison-bone bed originally extended northeastward across much, if not all, of the present blowout and that a part of the bone bed in the center of the blowout, where wind action is most severe, has been entirely destroyed. The major extension of the bone bed is apparently in a northeast-southwest direction, thus agreeing in trend with the former slope and drainage of the region. There is a possibility that the bone bed extends beyond the present excavations, both to the southwest and to the northeast. Further excavation is required to determine this possibility.

The bison bones are badly broken. Jaws, teeth, limb bones, and foot bones are abundant, but no skulls or horn cores other than fragments are preserved. All bones found are those of the bison, representing an extinct species appreciably larger than the modern species. Limb bones are numerous but usually poorly preserved. The broken condition of the bones is probably due to trampling by animals, particularly bison. Shallow water probably accounts for the lack of preservation of skulls. By utilizing the best preserved bones it was possible to determine that the area of the bone bed of approximately 800 square feet contained parts of at least 27 bison skeletons. Actually the area certainly contained parts of more bison than could be determined by the count of any particular bone of the skeleton.

Since the skulls are not preserved, it is difficult to determine the bison species. Of the foot bones, the astragalus is often the best preserved. Using this bone as an indicator of size, it appears from the evidence now at hand that the bison of the Milnesand locality is of about the same size or possibly slightly larger than the bison of the Plainview, Texas, locality, and is smaller than the bison of the Folsom horizon at the Lubbock and Blackwater localities. By the same test, the bison from the 4 localities mentioned are all definitely larger

TABLE 13. AVERAGE VOLUME OR SIZE OF THE ASTRAGALUS OF BISON SPECIES FOUND IN THE SOUTHERN HIGH PLAINS

Locality	*Stratigraphic Position*	*Number of Bones Tested*	*Average Volume in cc.*	*Relative Size*
Sitter Ranch, Texas	Prehistoric	16	75.4	100
Lubbock, Texas, Stratum 3	Post-Folsom	11	83.0	110
Plainview, Texas	Probably post-Folsom	25	104.16	138
Milnesand, New Mexico	Probably post-Folsom	30	108.6	144
Lubbock, Texas, Stratum 2	Folsom; age in years, 9883 ± 350	20	113.0	150
Lubbock Texas, Stratum 1	Gray sand, pre-Folsom	Bison present, but no astragali obtained		
Blackwater Draw, New Mexico	Portales complex, post-Folsom	Bison present, but no astragali obtained		
Blackwater Draw, New Mexico	Folsom; correlates with Lubbock, Stratum 2	4	124.4	165
Blackwater Draw, New Mexico	Brown sand, underlies Folsom zone	3	134.9	179
Blackwater Draw, New Mexico	Gray sand, pre-Folsom	Bison present, but no astragali obtained		

than the modern bison. Size alone does not sufficiently define species. However, information as to size is useful in comparing bison found in the successive zones or beds of a given locality and at nearby localities. Table 13 records the volume, or size, of the bison astragali obtained from several localities of the southern High Plains. The results, when only a few of the bones are available for volume determination, are to be accepted as suggestive only and become increasingly dependable with increased numbers from a given locality. Only essentially complete bones are used in these measurements. The bison astragali found at a given locality are, of course, not necessarily all of one species, which further complicates interpretation of results. The table of measurements here given is merely suggestive of the relative size of the bison species found at the several localities listed.

For comparison in size, the Sitter Ranch bison, which presumably is the modern species, *Bison bison*, is taken as 100. The bison of Stratum 3 of the Lubbock section is apparently but slightly larger than the Sitter Ranch species and may also represent the modern species, but not necessarily so. More of the skeleton is required to fully identify this fossil bison. The other bison listed in the table of measurements are notably larger than *Bison bison*. The bison of Stratum 2 of the Lubbock locality is *Bison antiquus* var. *taylori*, often referred to as *Bison taylori*.

The artifacts found in the bone bed include projectile points and scrapers. The projectile points are of sturdy construction, thin at the edges and thickening to a more or less pronounced median ridge or keel. Thinning of the edges has been secured by approximately transverse flaking from either edge. In some instances the central ridge is more pronounced on one side of the point than on the other. The base is thinned by the removal of numerous small flakes from each side, resulting in a wedge-like, prevailingly square base. At the tip the flaking, with some thinning on both sides, forms a sharp point. One in the lot is a midget point, being 20 mm. long and 13 mm. wide. Of 11 points obtained in place in the bone bed, 8 conform closely to this description (Nos. 2, 9, 10, 11, 12, 13, 14, and 26). One, number 3, is broken and the base is lacking. The remaining 2 (Nos. 15 and 16) are slightly concave at the base. Of the 12 points found on the surface in the blowout and derived mostly if not entirely from the bone bed, 8 (Nos. 27, 28, 29, 30, 31, 32, 39, and 40) conform closely to the type here described, and 4 (Nos. 4, 5, 33, and 34) have a slightly concave base. The base and sides of all of the projectile points are smoothed by grinding, the smoothed margin extending often ½ or more of the length of the point. The upward extent of the basal grinding has been indicated in the illustrations for most of the projectile points. This type of projectile point occurring in the Portales complex culture at the Blackwater Draw locality and at Milnesand may appropriately be known as the Milnesand point.

Five scrapers or cutting tools were found in place in the bone bed. One of these, made of flint (Fig. 98 *g*), has a few large flakes removed from one side. On the reverse side the margins are thinned by the removal of numerous small flakes. Two scrapers (Nos. 18 and 19), made from hard gray quartzite, are crudely worked. The flaking is slight, only a few small flakes having been removed from one side of each scraper. Another scraper or cutting tool (No. 20) is a flint flake retouched slightly on one side. The collection contains also a large flint flake (No. 21) with sharp edges which may have been used as a cutting tool or as a scraper.

Comparisons. To the assemblage of artifacts found in the uppermost artifact-bearing stratum in the lake fill at the Blackwater Draw locality near Portales, New Mexico, the writer in 1952 applied the term *Portales complex*. Of 22 projectile points obtained in place in this horizon and of which illustrations have been published (Sellards 1952), 3 are Eden points; 1 is a point with concave base suggestive of the Plainview type; 1 has a slightly concave base; and 2 are broken and lack the base. The remaining 17 points have a wedge-shaped base neither concave nor convex, the thinning of the base being produced by removing flakes from both sides. In general the square-based points of the Portales complex resemble closely the Milnesand points. There is, however, one fairly persistent distinction. Most of the Portales square-based points have the sides ground for only a short distance above the base, 10 to 15 mm., and some are almost imperceptibly notched at the termination of the smoothed area. Only one of the points has the sides ground for as much as 3/5 of the length of the point. However, in other respects the resem-

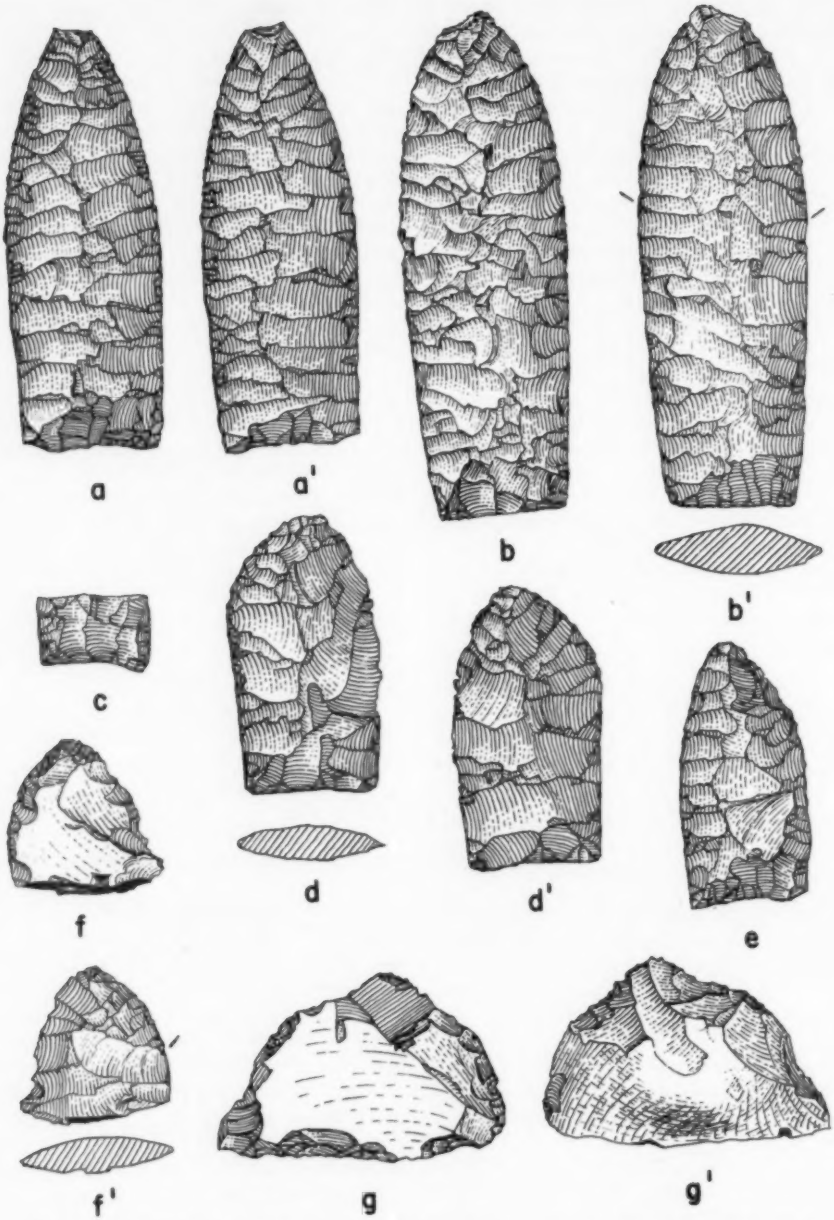

FIG. 98. Artifacts from the Milnesand locality. Specimen numbers in order, left to right: 13, 2, 15, 14, 12, 3, 17. All were found in place among the bison bones; *a*, *c*, *d*, and *e* remain in blocks of bone taken from the deposit. Natural size.

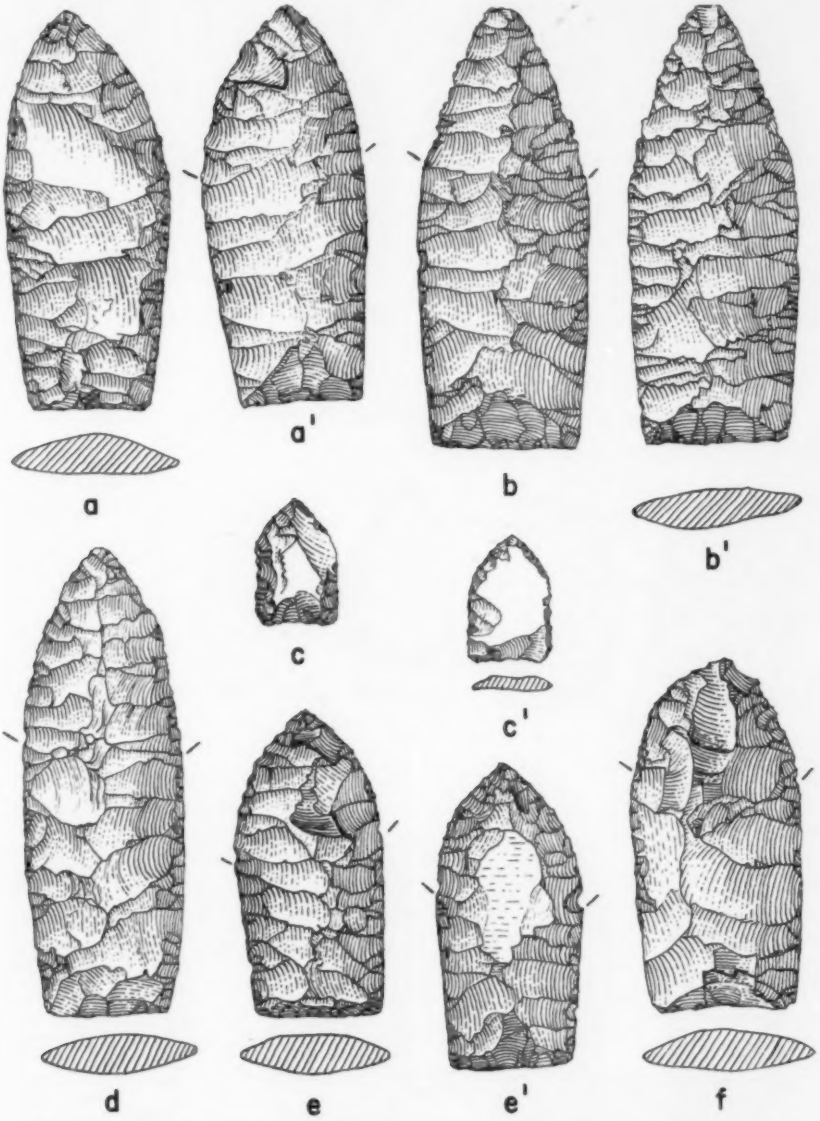

FIG. 99. Artifacts from the Milnesand locality. Specimen numbers in order, left to right: 9, 11, 27, 26, 39, 29. Nos. 9, 11, and 26 (*a*, *b*, and *d*) were found in place in the bone bed. The remaining 3 points shown here were on or near the exposed part of the bone bed and were apparently derived from it. Natural size.

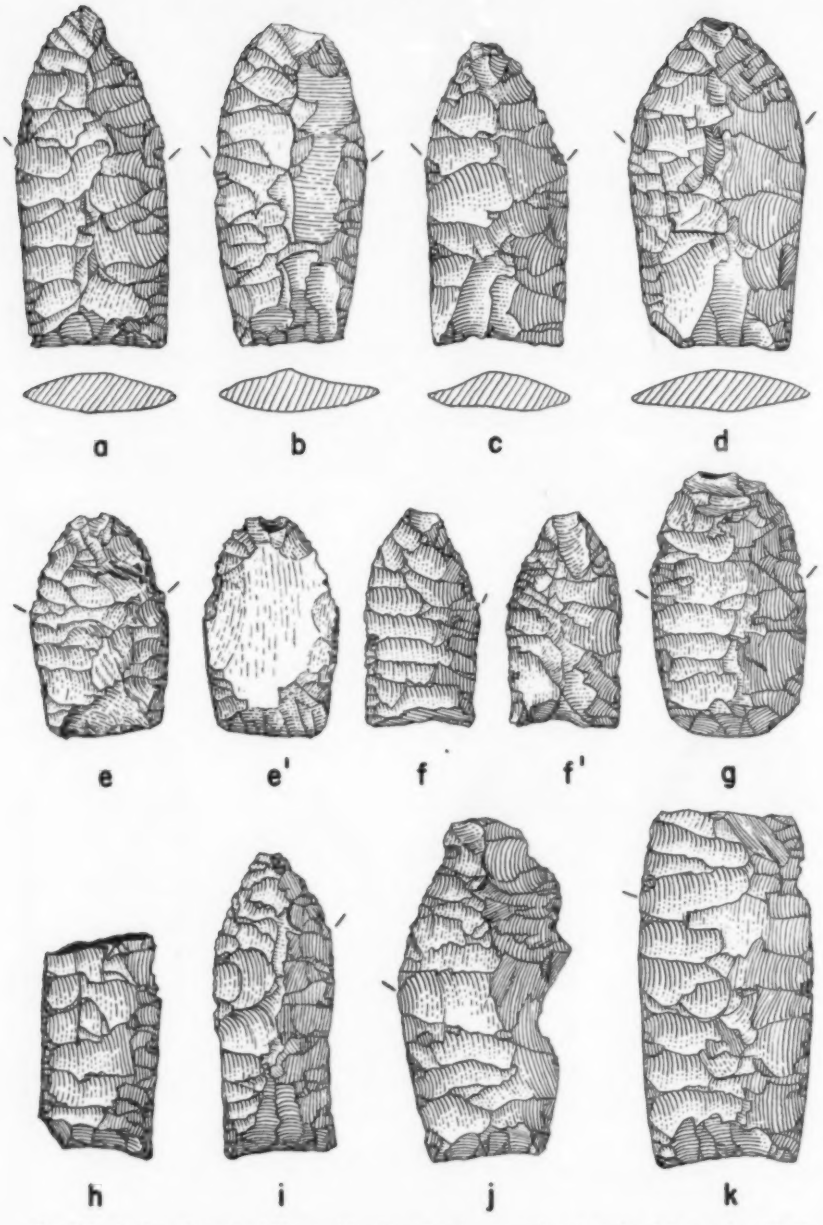

FIG. 100. Artifacts from the Milnesand locality. Specimen numbers in order, left to right: 28, 30, 34, 32, 10, 16, 40, 5, 4, 31, 33. Nos. 10 and 16 (*e* and *f*) were found in place in the bone bed. The remaining 9 points shown here were on or near the exposed part of the bone bed and were apparently derived from it. Natural size.

blance of the Milnesand points to the square-based points of the Portales locality is such as to imply a relationship if not an exact correlation between the points of the 2 localities.

The type locality of the *Plainview* points is Plainview, Texas (Sellards and others 1947). The most conspicuous difference between Plainview and Milnesand points is the prevailingly concave base of the former and the prevailingly square base of the latter. Both the Plainview and the Milnesand points are thinned at the base by flakes removed from both sides, some before and some after the side flaking had been done. They present, however, one notable difference. Plainview man usually secured a thinned base by striking off a few, 1 to 5 or 6, relatively large flakes, some 10 to 18 mm. in length. The Milnesand point makers habitually thinned the base by taking off numerous small flakes, from 5 or 6 to 8 or 9. The result is that the base of the Milnesand point terminates much more abruptly and is more distinctly wedge shaped and is stronger than is the base of the Plainview point. In this respect there is lack of complete uniformity. Thus, among the Plainview points previously referred to, one has

TABLE 14. ARTIFACTS FROM THE MILNESAND LOCALITY

The accession and locality number in the Texas Memorial Museum records is 1146. Each artifact has in addition a specimen number as here indicated. Measurements are in millimeters.

PROJECTILE POINTS

Spec. No.	*Description*	*Length*	*Max. Width*	*Max. Thickness*	*Illustration Text Fig.*
2	Brownish dark gray flint, complete	80	25	7	98 *b*
3	Dark blue flint, tip only	23	23	5	98 *f*
4	Tan colored flint, complete	48	19	3	100 *i*
5	Dark blue flint, base only	35	18	5	100 *h*
9	Blue gray flint, complete	63	26	5	99 *a*
10	Gray flint, tip reworked	35	21	4	100 *e*
11	Blue gray flint, complete	70	27	5.5	99 *b*
12	Dark gray flint	41	20	—*	98 *e*
13	Light gray and tan flint	67	25	—*	98 *a*
14	Light gray flint	48	24	5	98 *d*
15	Gray and tan mottled flint	12	17	—*	98 *c*
16	Milky quartz, broken at tip	35	18	4	100 *f*
26	Light blue gray flint, complete	74	26	6	99 *d*
27	Light tan flint, complete	20	13	2	99 *c*
28	Brownish gray flint, tip reworked	54	23	6	100 *a*
29	Variegated banded flint	55	27	6.5	99 *f*
30	Pinkish banded flint	55	23	6.5	100 *b*
31	Dark blue gray flint, tip broken	54	25	5.5	100 *j*
32	Light tan flint, complete	53	28	6.0	100 *d*
33	Buff gray flint, basal part	56	28	5.5	100 *k*
34	Yellowish gray flint, complete	47	22	5	100 *c*
39	Brownish blue gray flint, complete	49	23	6	99 *e*
40	Brownish red and gray flint, tip reworked	43	24	6.5	100 *g*

* Not measured as to thickness.

SCRAPERS

Spec. No.	*Description*	*Illustration*
17	Brownish dark gray flint	98 *g*
18	Hard gray quartzite	Not illustrated
19	Hard gray quartzite	Not illustrated
20	Light colored flint	Not illustrated
21	Light colored flint	Not illustrated

the base thinned by removal of many small flakes. Among the Milnesand points there is likewise some deviation from the standard practice. However, taken as a whole, one finds no difficulty in distinguishing, by the projectile points, a Plainview locality from the Milnesand locality.

In 1932 Barbour and Schultz described 8 artifacts found in association with fossil bison at *Scottsbluff*, Nebraska, including 4 projectile points and 4 scrapers. Through the kindness of C. B. Schultz, the writer has had the opportunity of examining these points in the Nebraska State Museum. One of the points is broken, the base not being preserved. One, although somewhat incomplete, evidently had a concave base. Of the other 2 points, one is definitely stemmed and is not closely related to the Milnesand points. The other is a shouldered point. The Milnesand points are, in the writer's opinion, distinct from all the points found at the Scottsbluff locality.

Age of the Deposits. Charred bison bones obtained from the Milnesand locality in March, 1953, have not as yet been determined as to age by radiocarbon test. As stated above, the artifacts of the Milnesand locality resemble certain of those of the Portales complex at Blackwater Draw and are believed to be of comparable age.

The Portales complex at the Blackwater Draw locality is separate from and overlies the zone containing Folsom artifacts. It follows, therefore, that the Milnesand horizon is also later, probably considerably later, than the Folsom horizon. For a more exact determination as to age it is necessary to await testing of the charred bison bones obtained at Milnesand, or to find some other means of determining the age. The age of the Folsom horizon, it may be added, as determined from charred bison bones from the Lubbock locality, has been given by radiocarbon test as 9883 $\pm$ 350 years.

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TEXAS MEMORIAL MUSEUM
Austin, Texas
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TWINED WATER BOTTLES OF THE CUYAMA AREA, SOUTHERN CALIFORNIA*

ALBERT MOHR AND L. L. SAMPLE

ALTHOUGH THE basketry of many parts of California is known ethnographically and a few archaeological descriptions are appearing, the textiles of the Santa Barbara region remain relatively unknown. The ethnographic information available on the historic occupants, the Chumash, has been limited by the early missionization and subsequent disintegration of native culture, and most archaeological reports of basketry from this area have been sketchy. It is hoped that the following discussion of twined water bottles from archaeological sites in northern Santa Barbara County will supply some needed information and indicate the relation of these water bottles to twined ones of the Great Basin and Southwest.

A few of the specimens described herein have been pictured by Kroeber (1925: 561, Pl. 53) with a mention of some weaves employed in their manufacture.

With one possible exception, all of the specimens are from the Sierra Madre Mountains of northern Santa Barbara County. This range, stretching in a general northwest-southeast direction, is bounded on the north by the arid Cuyama Valley and on the south by the precipitous Sisquoc Canyon. The principal streams of these 2 drainage areas, the Cuyama and Sisquoc rivers, flow roughly westward, later joining to form the Santa Maria River which discharges into the Pacific Ocean. The Sierra Madres themselves are of sedimentary origin, and weathering has produced many small dry caves in the sandstone outcrops. Vegetation throughout the mountains is heavy; at low elevations junipers and oaks are abundant while at the higher altitudes pines become numerous.

Little information accompanied most of the water bottles, but in some instances it was possible to obtain supplementary data by contacting the finders.

Two specimens (UCMA 1-19435, 1-19436) are part of a collection that includes a seed beater, an open-twined bowl, a coiled hopper-mortar hopper, and 2 coiled trays found by Grant Dewlaney about 1889. The only information concerning their provenience is that they are from Santa Barbara Canyon, a part of the Cuyama drainage system in the Sierra Madre Mountains.

The largest number of water bottles is part of a collection made about 1907 by James E. Heath in Santa Barbara National Forest (now Los Padres National Forest). A short time later the material was handed over to the Department of Agriculture, for it had been collected on federal land. Six water bottles (UCMA 1-14498 to 1-14503), a hat or bowl, a storage basket, and a burden basket were placed in the University of California Museum of Anthropology and the remainder of the collection, 6 water bottles (USNM 255752, 255753, 255755 and 3 others not described herein), a wooden scoop, and an antler wedge, was shipped to the National Museum. The original papers relating to this collection state that it was gathered from Montgomery and Salisbury potreros on the north side of the Sierra Madre Mountains; in a recent communication, however, Mr. Heath states that 6 or 8 of the water bottles were found cached in a very small cave in Lion Canyon below Montgomery Potrero. The tops were sticking up, but the lower portions were buried. It is interesting to note that, of the 9 Heath specimens examined, 5 (UCMA 1-14498 to 1-14500) had varying amounts of a sandy, light-colored material adhering to the sides.

* The authors are indebted to the following institutions and individuals for making basketry available for this study: Bowers Memorial Museum, F. E. Coulter; J. G. James of Cuyama, California (private collection); Los Angeles County Museum, Robert Ariss; Santa Barbara Museum of Natural History, Phil C. Orr; Southwest Museum, M. R. Harrington and Ruth Simpson; U.S. National Museum, F. M. Setzler; University of California Museum of Anthropology, E. W. Gifford. In the text, catalog numbers of specimens from the above repositories and collections are prefixed BMM, J, LACM, SBM, SWM, USNM, and UCMA respectively. We are particularly grateful to the National Park Service Museum at Boulder City, Nevada, and Albert Schroeder for arranging the loan of the National Museum specimens, to Leo Hitchcock of the University of Washington for making a number of botanical identifications, and to the office of the Los Padres National Forest, U.S. Forest Service, for geographical information. We further wish to thank W. W. Elmendorf and Douglas and Carolyn Osborne for helpful suggestions. Permission to reproduce the University of California Museum of Anthropology photographs was granted by T. D. McCown.

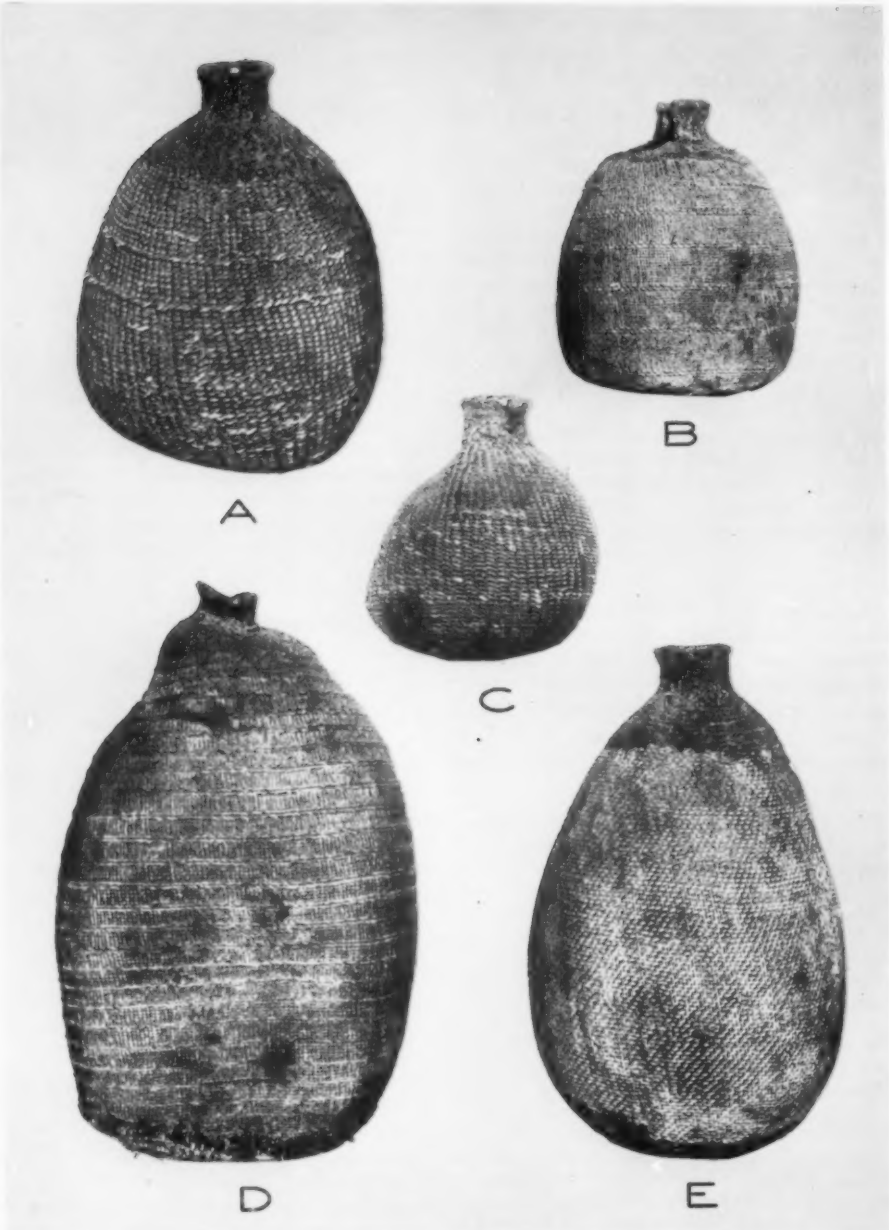

FIG. 101. *a-d*, Cuyama type water bottles (UCMA 1-14501, 1-14502, 1-14503, 1-14498); *e*, 2-strand diagonal twined water bottle (UCMA 1-14499). Scale, 1/5.

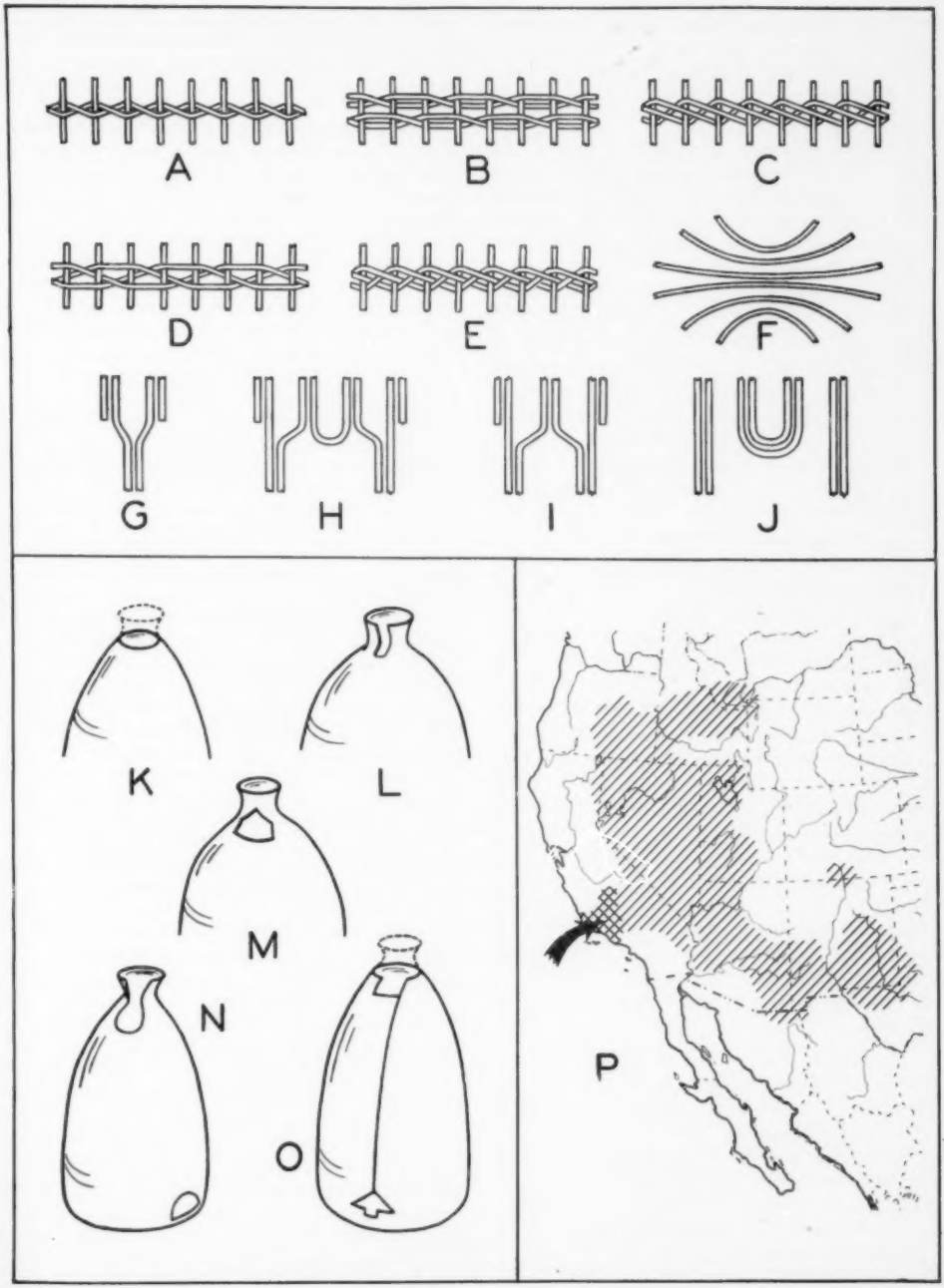

FIG. 102. *a*, 2-strand simple twining; *b*, 2-strand diagonal twining; *c*, 3-strand diagonal twining; *d*, 3-strand parallel twining; *e*, 3-strand braided twining; *f*, primary warp arrangement; *g-j*, methods of inserting new warps; *k-o*, types of alterations; *p*, distribution of Great Basin type (hatched) and Cuyama type twined water bottles (cross-hatched). Arrow indicates location of Cuyama area.

Presumably this was noncultural weathered material from the roof of a sandstone cave. The other bottles of this collection had been scrubbed but once may have had similar deposits.

A single specimen (UCMA 1-20962), the gift of Mrs. P. A. Hearst, is listed only as being from Cuyama. It is known, however, that the basket was purchased from a Mr. Cox, who collected with James Heath in the Sierra Madre Mountains.

Two water bottles (SBM 435, 436) acquired by the Santa Barbara Museum of Natural History were found on the floor of a cave in Wellman Canyon on the south slope of the Sierra Madre Mountains in the drainage of the Sisquoc River. No other cultural material is known to have come from this site.

Two specimens were found by J. G. James in a shelter located in a small tributary of Salisbury Canyon on the north side of the Sierra Madre Mountains (site 4SBa468). The cave, which recently collapsed (probably during the 1952 earthquake), is described by Mr. James as 10 feet deep, 15 feet wide, and high enough to stand in. The water bottles were cached together beneath a shallow layer of dirt. Other basketry, matting, and antler artifacts were found in the cave. One bottle (SWM 217-L-9) has been loaned to the Southwest Museum by A. H. Heller; the second (J-1) is in Mr. James's collection. Another water bottle (J-2), also in the James collection, was found unassociated on the surface of a very small cave somewhat farther up Salisbury Canyon.

A single specimen (BMM 8423) has been placed on loan in the Charles W. Bowers Memorial Museum by Mrs. Gordon Wilde. It appears to have been collected from the upper portion of Salisbury Canyon just south of the James Ranch. No details were known to the museum.

Description of the Water Bottles. The water bottles have been segregated into 2 groups for purposes of description: Cuyama-type water bottles (17 specimens), and 2-strand diagonal-twined water bottles (1 specimen). The piece separately treated resembles the Cuyama type but possesses several distinctive traits characteristic of Great Basin specimens making a separate category seem preferable.

Several modifications of the commonly used names of weaves have been made owing to the presence of a type of 3-strand twining for which the authors were unable to find an accepted appellation. In this paper a binomial system is used to designate each weave. The first part states the number of weft elements, that is, 2-strand or 3-strand; the second is a distinguishing descriptive term. Thus the weave often referred to as "simple (or plain) twining" is called 2-strand simple twining (Fig. 102, *a*); "diagonal twining" is called 2-strand diagonal twining (Fig. 102 *b*); "3-strand twining" is called 3-strand diagonal twining, diagonal referring to the slant of the exposed portions of individual weft elements (Fig. 102 *c*); "3-strand braid" is called 3-strand braided twining (Fig. 102 *e*); and the 3-strand weave for which we know no previously used name is called 3-strand parallel twining, parallel referring to pairs of exposed weft elements which are approximately parallel to the course (Fig. 102 *d*).

Cuyama-type Water Bottles

Form. All specimens with upper portions intact have small necks and slightly flaring rims. Body form grades from barrel shape, typical of the largest examples (Fig. 101 *d*), to a half-ellipsoid form (with point of maximum diameter near the bottom) found in medium- to small-sized pieces (Fig. 101 *a*). The bases are usually at least slightly concave but a few are either flat or very gently convex. These variations in basal form are probably of little significance; it seems reasonable to suppose that the fabricators desired a base on which the vessel could be easily stood but found it technologically difficult, at least in the primary stages, to add warps at a rate which would produce a perfectly flat yet tightly woven bottom. One small basket (UCMA 1-14503) differs from the rest in being globular in form (Fig. 101, *c*).

Size. Height (10 specimens): range 22-48 cm., mean 34 cm. Diameter (17 specimens): range 15-31 cm., mean 23 cm. Diameter of rim (9 specimens): range 4.5-7.5 cm., mean 6.2 cm. Height of neck above maximum constriction (9 specimens): range 2.5-5.1 cm., mean 3.8 cm. Diameter of neck at greatest constriction (13 specimens): range 4.0-7.0 cm., mean 5.5 cm. Estimated capacity: range 2.6-29.9 liters, mean 11.4 liters.

Weave. The basic weave of the Cuyama type is 2-strand simple twining. Slant is down to the right except for UCMA 1-14501 where it is down to the left, and direction of work is counterclockwise when looking into the basket except for USNM 255752 and SBM 435 which are clockwise. The atypical combinations of direction of work and slant, as Cressman has pointed out (1942: 35), result in a loose weave.

Twelve of the specimens have 2-ply S-twisted warp. The remaining 5 have 2-strand untwisted; in 2 of these the warp is increased to 3 strands in places. The number of warps is most commonly increased by separating the 2 strands of an existent warp and adding 1 new strand to each (Fig. 102 *g*). Three methods occurring more rarely are illustrated in Figure 102 *h-j*. In many of the baskets the warp number is increased or decreased only at decorative bands.

The number of weft courses ranges from 9 to 28 per 5 cm. with a mean of 17 per 5 cm. The number of warps ranges from 5 to 24 per 5 cm. with a mean of 13 per 5 cm.

The rims of all the specimens which retain their necks have been finished by cutting off the warp stubs even with the last course of twining (selfrim). With one exception, the bottom, where it is intact, is covered with asphalt so that no observation of the starting technique can be made without mutilation of the specimen. The basic warp arrangement of the one that could be examined is shown in Figure 102 *f*, but the exact method of starting the twining is not clear.

Decoration. Fourteen specimens are encircled by bands of a weave different from that which makes up the major portion of the basket. Kroeber has spoken of these bands as reinforcement (Kroeber 1925: 561); since somewhat similar contrasting stitches are reported as decorative among the Havasupai and Shoshone (Spier 1928: 131-2; Steward 1941: 240), we are inclined to look on them as a decorative device. In the Cuyama baskets these bands are 2-strand diagonal, 3-strand diagonal, 3-strand parallel and 3-strand braided twining. One, 2, or even 3 decorative weaves may occur in a single specimen. An added variation is achieved by reversing the slant of the twining of 1 of 2 paired courses of decoration. The illustrations convey the general effects obtained, and the specific design combinations are listed for each of the decorated baskets in the following form. The number of courses of each weave is given in order starting with the highest design band, which is a few centimeters below the neck constriction, and ending with the lowest design band, which is at or near the point where the vessel rests when placed on its base. A letter designates each course of the contrasting weaves: A = 2-strand diagonal twining, B = 3-strand diagonal twining, C = 3-strand parallel twining, D = 3-strand braided twining, while intervening courses of 2-strand simple twining which make up the body of the basket are indicated only by their number. Where the slant of the 3-strand diagonal twining is reversed from that used in adjoining courses, the code letter is in lower case "b." In order to make the design bands clearer, the courses composing each are enclosed within parentheses, and in 2 instances, isolated courses of 2-strand simple twining have been included in parentheses because they appear as a part of the design element. An exception to the stated location of the design bands is found in UCMA 1-14501. On this specimen the 2 bands are located about half way down the side.

Asphalt Coating. This has been applied to the interior of each specimen, to the exterior of the base and to the outer side of the neck section from the rim to a point 4 to 5 cm. below the constriction. The only exception to this is SBM 435 which is not coated on the exterior of the base. Sometimes the outer asphalt covers 1 or 2 design elements. The external asphalting may be directly related to structural features of the water bottles. The bottom is more subject to deformation than the sides owing to its shape, and, with contents weighing up to 30 kilograms, extra stiffening may have been needed to prevent cracking the lining. Since the neck is comparatively small and projecting, similar strengthening would help to protect it from the exigencies of use.

Materials. With one exception, all of the Cuyama water bottles appear to be of the same material. Four samples from 2 specimens (a warp and a weft of each) were found to be of the same material, probably the

UCMA 1-14498: (B) 2 (BB) 4 (BB) 4 (BB) 4 (BB) 3 (BB) 4 (BB) 4 (BB) 5 (BB) 5 (BB) 5 (BB) 5 (BB) 5 (BB) 4 (BB) 4 (BB) 4 (BB) 4 (B) 5 (B) 5 (B) 5 (B) 6 (B) 6 (B) 5 (B) 4 (B) 4 (B) 5 (B)

UCMA 1-14500: (AA) 20 (C) 19 (B) 11 (B) 11 (C) 14 (C) 12 (C) 7 (C)

UCMA 1-14501: (B) 7 (B)

UCMA 1-14502: (B) 10 (AA) 10 (AA) 13 (AA) 15 (AA) 15 (AA)

UCMA 1-19435: (BB) 10 (C1C) 9 (C1C) 9 (C1C) 8 (C1C) 8 (C1C) 8 (C1C) 7 (C)

UCMA 1-19436: (C) ? (CC) 4 (C) 3 (C) 9 (CC) 8 (C) 6 (CC) 5 (C) 4 (C) 4 (CC) 6 (C) 2 (CC) 6 (C) 4 (C) 4 (CC) 4 (C) 2 (C)

UCMA 1-20962: (AAAAAA) 3 (A1A1A) 8 (A1A1A) 7 (A1A3A) 8 (A1A1A) 7 (A1A2A) 8 (A1A1A) 7 (A1A1A) 7 (AAA) 8 (AAA) 7 (AA)

SWM 217-L-9: (B) 5 (B) 5 (B) 5 (B) 5 (B) 6 (B) 5 (B) 6 (B) 6 (B) 6 (B) 5 (B)

USNM 255752: (B) 14 (B) 20 (B) 23 (B) 15 (B)

USNM 255753: (B) 6 (B) 9 (B) 13 (B) 13 (B) 13 (B) 14 (B) 12 (B) 11 (B) 10 (B) 9 (B) 8 (B)

SBM 435: (BB) 10 (BB) 10 (BB) 9 (BB)9 (B)

BMM 8423: (A) 7 (A) 6 (A) 6 (A) 7 (A) 8 (A) 7 (A) 8 (A) 6 (A) 6 (A) 6 (A) 6 (A) 6 (A) 6 (A) 6 (A) 6 (A) 6 (A) 5 (A) 4 (A) 4 (A)

J-1: [top missing] (B) 6 (D) 5 (D) 5 (C) 5 (C) 5 (C) 5 (C) 5 (C)

J-2: (BBB) 6 (BB) 9 (BB) 8 (BB) 7 (BB) 6 (BB) 7 (BB) 8 (Bb) 10 (BB) 8 (Bb) 8 (BB) 8 (Bb) 7 (BB) 7 (BB) 7 (Bb) 7 (AA)

stem of *Juncus* sp. The plants used in the fabrication of UCMA 1-14503 were definitely different, the warp probably being the stem of *Clematis ligusticifolia* and the weft the split leaf of *Yucca whipplei*.

Repairing. The original bottom of water bottle UCMA 1-14498 was apparently worn (or broken) out, but the vessel was fitted for further use by being upended and having a new bottom coiled on in a counterclockwise direction, worked from the outside to the inside. The technic of the repair is close coiling on a bundle foundation with noninterlocking stitches which are occasionally split on the nonwork (inside) surface. Splices were effected by bending the moving end of the old splint in a counterclockwise direction on the nonwork surface and the fag end of the new splint in the same direction on the work surface, both being caught under the first 1 or 2 stitches of the new splint. Number of stitches per 5 cm.: 6. Number of coils per 5 cm.: 7. Bundle: *Artimesia californica*. Splint: possibly split stem of *Baccharis viminea*. When a hole 2 cm. in diameter remained in the center of the coiling, it was dobbed with asphalt and plugged with fine grass. This was followed by a patch of twined basketry (6 by 3.5 cm.) already asphalted on both sides (possibly a piece of the original bottom) cemented on with the same adhesive. The line of juncture between the body of the water bottle and the coiled bottom was also smeared with asphalt, but the repair itself was not waterproofed.

Remarks. UCMA 1-14503 was included in the Cuyama type with some misgivings because of its aberrant shape; however, a typological segregation was not deemed justifiable at this time. Notably its materials are not *Juncus* as in the rest of the specimens but are the same as those used in the 2-strand diagonal twined specimen described below.

Two-strand Diagonal Twined Water Bottle

Form. The form of this vessel (UCMA 1-14499) is adequately depicted in Figure 101 *e* save for the bottom which is concave.

Size. Height: 43 cm. Diameter: 28 cm. Rim diameter: 7.5 cm. Neck diameter: 6.5 cm. Height of neck above constriction: 2.5 cm. Estimated capacity: 19.5 liters.

Weave. The basic weave is 2-strand diagonal twining; the 6 cm. immediately below the neck constriction, however, are of 3-strand diagonal twining, and above this the neck is finished in 2-strand simple twining. A down-to-the-left slant with a counterclockwise direction of work has again resulted in a rather loose weave. Warps are a single strand; their number is increased by adding a second strand to an existent warp for 1 twining course and then separating the 2 strands into separate elements on the succeeding course. The rim is finished by coiling a splint around the last course of twining in a counterclockwise direction. Asphalt obscures the starting technic. Number of weft courses per 5 cm.: 13-14. Number of warps per 5 cm.: 9.

Since the only variations in the weave are restricted to the neck area and are covered by asphalt, they are probably not decorative.

Asphalt completely covers the interior of the vessel. It has been used also on the outside of the base to a point 4 cm. up the side and on the exterior of the neck and body to a point 6 cm. below the neck constriction.

Material. The weft is probably the split leaf of *Yucca whipplei*, the warp possibly the stem of *Clematis ligusticifolia*.

Age. Circumstances surrounding the discovery of the water bottles preclude an age determination consistent with generally accepted archaeological standards. There are, however, several lines of inference which may be useful in tentatively assigning a temporal position. The reported existence of similar water bottles in recent times among the Chumash (Harrington 1942: 22) and at Buena Vista Lake 30 miles to the northeast (Wedel 1941: 126-7, Pl. 146) is worthy of note. Also, the general character of the material found in the Cuyama Valley caves appears to be late (personal observation). The archaeological literature for Santa Barbara indicates that water bottles with asphalt linings are not uncommon in late sites but thus far are unknown from sites of earlier age (Rogers 1929). The great similarity of the baskets is suggestive of general contemporaneity, and it seems unlikely that this large number of specimens would survive from an early period in which they are otherwise rare or absent, preserved in caves that have yielded little or no recognizable early material. These points suggest that the specimens are from the late cultural period, which in its final phase is identifiable with the historic occupants of the region, the Chumash. It is entirely possible that the water bottle was used through a moderately long time span even within this period, and perhaps, when a careful study is made of the asphalt linings found in open sites, regional and/or temporal differences in style will be apparent.

Use. Historically and ethnographically, asphalted baskets are known to have been used as water containers. As early as 1769 Costanso (1910: 44-5) writes of Santa Barbara basketry, "The large vessels which contain water are made of a very strong textile of rushes, tarred [*embreados*] on the inside, and they give them the same shape as our *tinajas*." Similar information is recorded by Harrington (1942: 22).

Although none of the water bottles are known to have had contents when discovered, a few seeds and nuts adhering to the asphalt suggest that the baskets may have been employed to store food stuffs, a parallel to the use of small water bottles as granaries by "Shoshonean" peoples (Mason 1904: 489-90). In 5 instances pine nut shells were found imbedded in the exterior basal coating and, in 2 cases, were observed adhering to the interior asphalt. Other vegetal remains include a few sunflower seeds inside 1 specimen, seeds of a *Cyperaceae*, either a *Carex* or *Scirpus*, on the base of 1 bottle, and the seeds of *Juniperus californica* on the bottoms of 2 specimens. The use of the bottles at a habitation where pine nuts were eaten, and in particular their use in pine-nut camps would account for the shells on the outside. Nut shells found on the inside may have become attached if the baskets were carried back from the mountains full of pine nuts or were used to store nuts either at home or in caches. Juniper berries are edible and certain species of *Carea* and *Scirpus* have been used both for food and textile materials, but since they were attached to the exteriors of baskets they mean little. Dr. Hitchcock feels fairly certain that the sunflower seeds are not of the native type; they were found in a Heath collection specimen and may have been introduced into the basket since its discovery.

Secondary use of the Cuyama type water bottles is also indicated by the removal of sections of 11 of the 17 specimens. One basket has a hole 8 by 6 cm. cut into the neck constriction reaching 2 cm. into the neck and 4 cm. into the body (USNM 255752; Fig. 102 *m*). A vertical slot 1.5 to 3.0 cm. wide has been cut down through the neck and about 2 cm. into the bodies of 3 baskets (Fig. 102 *l*); the lower portions of 2 of these slots have been widened to 5.0 and 6.4 cm. (UCMA 1-14502, BMM 8423). In addition 2 of the 3 pieces have a hole cut in or near the base. One aperture 8 by 14 cm. and trapizoidal in shape was cut through the periphery of the repaired (coiled) bottom (UCMA 1-14498); the second is a semilunar opening, 10.2 by 5.1 cm., at the lower margin of the side of BMM 8423 (Fig. 102 *n*). The entire neck or the neck and a small segment of 1 side was removed from the remaining 7 specimens leaving apertures averaging 7 cm. in diameter (UCMA 1-14500, 1-14502, SBM 435, 436, USNM 255753, 255755; Fig. 102 *k*). One of the vessels so altered is further modified by removal of a triangular section near the bottom of one side and by a long vertical slit through all the weft courses from the top to the apex of the triangle (UCMA 1-20962; Fig. 102 *o*).

Modified specimens were gathered by 5 different collectors and may, therefore, be considered indicative of a cultural pattern rather than an individual variation. Since the bottles were not with burials, but concealed or cached in caves, and were, with one exception, in apparent good condition when the cuts were made, it seems reasonable to believe that the changes were connected with use. The modifications in some cases preclude the basket's further use as a water container or granary for seeds and nuts. And unless the food material stored was very coarse, the increased size of neck of some specimens would be of little advantage. It may be suggested that the piece with the slit along one side was intended to house (wrap) some bulky object. Although there seems little question then that the baskets were constructed primarily to contain and transport water, an adequate explanation of the modifications and implied secondary use awaits additional evidence.

Comparisons. Among the technics used in the Cuyama water bottles, the 3-strand parallel twining is of particular interest. No occurrence of this weave was found in the publications examined, and inquiries made of individuals possessed of considerable experience with basketry have not been fruitful. It appears, therefore, that the weave must be unusual, at least in the western part of the United States, or has previously not been distinguished from other types of 3-strand twining. Although 3-strand parallel twining is used in only 4 specimens, probably it is not a variation of a single basket maker because the examples are from 3 different collections.

Groups using the twined water bottle occupy portions of the Great Basin, the Southwest, and California. They include the Northern Paiute, Washo, Shoshone, Gosiute, Eastern Achomawi, Southern Paiute, Havasupai, Ute, Walapai, Yavapai, Apache, Chumash, Gabrielino, Yokuts, Kitanemuk, Serrano, Kawaiisu, and Tubatulabal. Salinans and Costanoans are not included because evidence is indefinite or conflicting (Harrington 1942: 22; Mason 1912: 146). Available data, though incomplete, ap-

pear to provide the basis for a rough division of the twined water bottle distribution into at least 2 major subareas, each characterized by a relatively distinct complex of characteristics.

The first of the subareas encompasses the territory of the Chumash and much of that of the southern Yokuts. The dominant style seems to be the principal one described in this paper, the Cuyama type (Fig. 102 *p*). Its characteristics may be summed up as follows: a form ranging from barrel shaped to half elipsoid, with flatish or slightly concave base, a definite neck with small mouth, flaring lip, and self rim; a basic weave of 2-strand simple twining often interspersed with a number of courses of 2-strand diagonal, 3-strand diagonal, 3-strand parallel, and, rarely, 3-strand braided twining; the whole interior, and neck and base of exterior coated with asphalt; handles and lugs absent.

Aside from the description contained in this paper, published data indicative of the existence of the type are scanty, and one is forced to depend largely on incomplete accounts, a practice admitting a considerable chance for error. One find, an asphalt lining from Dos Pueblos on the Santa Barbara Channel, is described as bottle-shaped with neck and rim diameters of 1 and 2 inches respectively. The illustrations show that it was made with 2-strand simple twining on a 2-3 strand parallel warp with 9 warps per 5 cm. and 17 weft courses per 5 cm. The distribution of the asphalt coating seems to be of the Cuyama pattern (Putnam 1879: 245, Pl. 14, *Fig. 7-10*). Ethnographically Harrington (1942: 22) states that Santa Inez and Ventura Chumash made "definitely r cked" asphalted twined water bottles with flat bottoms and contrasting "three strand twining." He also says that the direction of work was clockwise, a point not only at variance with the majority of Cuyama pieces but with general practice in North America (Weltfish 1930: 482). Possibly direction was reckoned while viewing the basket from the bottom rather than from the top. From the Buena Vista Lake region in the southern San Joaquin Valley, Wedel (1941: 126-7, Pl. 14*b*) describes a nearly whole archaeological specimen which, from the text and illustration, appears to be of the Cuyama type in weave, asphalting, and general form. Nearby, Walker (1947: 10, 29-30) found a number of water bottles in a historic Yokuts cemetery site. Their shapes are suggestive of the Cuyama type, but lack of details precludes other comparisons. Ethnographic evidence for the valley is limited to Driver's report (1937: 78) that a small, flat or round-bottomed, "plain twined" water bottle was made by the Nutunutu, Tachi, Chunut, Yaudanchi, and Yanelmani Yokuts.

These scattered references to the Santa Barbara and San Joaquin areas suggest the presence of the Cuyama type water bottle as the dominant one through Chumash and southern valley Yokuts territory. Doubtless the picture could be greatly clarified by the description of known archaeological finds.

The second subarea includes the Northern Paiute, Shoshone, Gosiute, Eastern Achomawi, Southern Paiute, Havasupai, Ute, Walapai, Yavapai, Apache, Kawaiisu, Tubatulabal, and possibly the Washo, Kitanemuk Serrano, and certain marginal Yokuts (Fig. 102*p*). Here the character of the water bottle centers around a complex of traits which will be referred to as the Great Basin type. The basic weave is 2-strand diagonal twining sometimes decorated by a few bands of 3-strand diagonal twining. Mouths tend to be quite wide; the lip usually is a coiled rather than a selfrim type; waterproofing with pitch covers the whole vessel inside and out and is frequently preceded by a coat of red paint. Usually loops or lugs for transport and suspension are attached to the walls. Several body forms are present and frequently are made by the same group. The most common and widespread variations are the biconical and globular forms. The hourglass form and the globular type with concave bottom occur but are not nearly so numerous (Driver 1937: 78; Drucker 1937: 20; 1941: 110; Gifford 1932: 219; 1936: 281-2; 1940: 44; Harrington 1942: 22; Kroeber 1935: 80, Pl. 9; Kroeber 1925: 571, 605, 701; Kelly 1932: 124; Lowie 1924: 234-7, 241, Fig. 20; Roberts 1929: 150-3; Spier 1928: 124-33; Steward 1933: 273, 290, Pl. 91; 1941: 240-1, 292; 1943: 217, 373; Stewart 1941: 387; 1942: 271; Voegelin 1938: 32, 1942: 78, 194). The variations present within the Great Basin type indicate that further typological subdivisions probably could be made within this general grouping.

From the above summary it can be seen that the single specimen of 2-strand diagonal twining described displays some features prominent in the Cuyama type and some frequently found in the Great Basin type water bottles. The sig-

nificance of the specimen is not clear; it could be an example of a definite minority type present in the region, a variant made by a person who had seen the Basin type baskets, the basket of an individual who had married in from a group making baskets of this type, or a piece traded in from some other area. In this connection it is pertinent to note the discovery of a water bottle in Los Angeles County (LACM-no museum number) displaying much the same combination of traits found in the Cuyama 2-strand diagonal-twined specimen. Although the constructional details of the water bottles used by the occupants of this region, the Gabrielino, are not known, this specimen may be an indication of the type used by them and a partial explanation of the appearance of the type in the Cuyama area.

Even though the exact relationship between the 2 or possibly 3 varieties of twined water bottles is not clear at the present there is reason to expect that future work will provide the solution to the problem. Dry-cave specimens in the Great Basin and asphalt impressions on the coast and in the San Joaquin Valley should provide a relatively continuous record of water-bottle development. If we may rely on the account, what appears to be an asphalt lining has already been found in an early southern California site, but the poor preservation of the specimen has precluded analysis (Treganza and Malamud 1950: 149). In the future similar but better preserved finds may provide important historical data; for the present it would be particularly helpful to have descriptions of the many late-period asphalt linings so frequently enumerated but seldom described in the archaeological literature.

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UC-AR *University of California, Anthropological Records.*

UC-PAAE *University of California, Publications in American Archaeology and Ethnology.*

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ARCHAEOLOGY OF WILDROSE CANYON, DEATH VALLEY NATIONAL MONUMENT

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WILDROSE Canyon, the site of the summer headquarters of the National Park Service for Death Valley National Monument, is on the west side of the Panamint Range in eastern California. The canyon, which runs in a roughly east-west direction, is about 13 miles long. Structurally, its width widens from its mouth where it measures less than ¼ of a mile inland to a maximum of 1½ miles and then narrows again in its upper reaches. There is a general upslope of the valley floor from about 4000 to over 8000 feet in elevation.

The valley is flanked on either side with rugged mountains which rise steeply above its floor. Their sides are furrowed with many gulches and narrow canyons and the lower slopes are piled high with rock debris. The uneven valley floor is covered with boulders, gravel, sand, and silt washed down from the surrounding heights. Branch canyons extend back into the mountains at many points, dwindling to narrow gorges in their upper reaches.

This is a semiarid region, as the high Sierra Nevada peaks to the west shut off moisture-bearing winds from the Pacific. The average yearly precipitation probably does not exceed 10 inches. Much of this falls during summer thunderstorms with occasional heavy downpours in the surrounding mountains. These result in a heavy runoff and are extremely destructive as detritus is carried down from the bare mountain slopes in enormous quantities. The rainstorms are supplemented in the upper Wildrose Canyon by winter snowfall, which occasionally reaches down to the mouth. An effect of little precipitation is the scarcity of surface water. The drainage systems are dry except after heavy storms when they are transformed into watercourses or even torrents which run for only a few hours. Springs producing a continuous flow of water from the ground are correspondingly small and few in number with only 6 in the district.

The season of greatest warmth is from May to October. Summers are surprisingly hot for the elevation, with temperatures of more than 100° F. recorded. The altitude is great enough, however, to give cool nights. The temperature is subjected to great variations not only between day and night but also between summer and winter. Winters are bitterly cold. Winds throughout the year are variable, often strong and steady, becoming gusty at times.

The lower valley is destitute of trees and is dotted with low brush among which common greasewood and bursage are most noticeable. Along with these, on the more rocky slopes, are creosote bushes. The upper valley from about the 6000-foot level has thin forests of single-leaf pinyon which is among the most drought resistant of Western cone-bearing trees, and Utah juniper. They are supplemented in higher elevations by mountain mahogany. In the moister soils adjacent to stream courses and particularly around springs are willows and occasional cottonwoods. The only other vegetation of consequence in the higher zone is sage and Mormon tea. Occasional clumps of grizzly bear prickly pear cactus occur.

Wildlife is not particularly abundant. The following observations were provided by Floyd Keller, Chief Naturalist, Death Valley National Monument. The native mammals are primarily small forms, especially rodents and rabbits. Of the former there are the desert antelope ground squirrel, Panamint chipmunk, white-footed mouse, jumping mouse, and Thomas wood rat. The Colorado desert jack rabbit and the cottontail are both present. Carnivores are represented by the desert kit fox, desert coyote, and an occasional desert bobcat. Nelson bighorn sheep make their home in this region, the only native ungulate known to occur. Neither deer nor antelope have been authoritatively reported. Several species of bats round out the list of mammals. Reptiles, mainly lizards, are the most conspicuous element of the animal life, ranging from the large herbivorous chuckwalla to the small banded gecko. Bailey's collared lizard, the leopard lizard, and other species are also known. Snakes are present though seemingly rather scarce. The red racer, Boyle's king snake, Great Basin gopher snake, and Panamint rattler have been noted. The sidewinder may live in the area. Agassiz's tortoise has also been reported. Wildrose Canyon is on the migration flyway for birds and during the spring and fall many species are present. Quail, hummingbirds, and jays are to be seen as are such raptorial birds as hawks,

ravens, and owls. The number of species summering and breeding in the canyon is comparatively small, however.

Wildrose Canyon was visited seasonally by Death Valley Shoshone. The main subsistence area for the Furnace Creek people was in the Panamint Mountains (Steward 1938: 92) and several of their summer camps were in Wildrose. The canyon was easily entered from Death Valley Canyon, on the east slope of the Panamints, which leads directly from the floor of Death Valley to upper Wildrose. Another possible, though more circuitous route was through Emigrant Pass, the main passage westward through the Panamints. One summer campsite was at a spring called Ko'near, at the head of Death Valley Canyon. From here it was but a short journey to Mahogany Flat at the end of Wildrose Canyon. A spring at the head of Wildrose, Wabüits (Thorndike's?), was sometimes a camping spot. Another camp was at Wildrose Spring in the lower valley. The same territory was visited year after year. Indians from Panamint Valley to the west may also have entered Wildrose.

The nuts of the pinyon or nutpine, upon which they placed their chief dependence for food, attracted the Death Valley Shoshone to Wildrose Canyon. By early fall the nuts began to ripen and the people moved in to harvest them. The yield varied considerably from year to year with abundant crops coming every few years. When particularly good, a large surplus could be accumulated of a food that with its thick shell would keep for a year or two. Part of the harvest was cached in the mountains. It is not known whether pine-nut expeditions ever wintered in the mountains when crops were especially good. Occupation during this season would have been uncomfortable at best.

Fig. 103. Wildrose Canyon looking west from Mahogany Flat, with the Sierra Nevada Mountains in the background.

Although the pinyon nut was the primary attraction, the seeds and edible portions of other plants also furnished food. The mountain sheep was certainly an attraction, as well as smaller game animals and birds.

This country was until quite late in the 19th century virtually untouched by western civilization. It was then entered by miners and woodcutters. Several small mining centers grew up and a settlement was established around the Charcoal Kilns which furnished charcoal for the Modoc Mine across Panamint Valley west of Wildrose. Little of the aboriginal material culture survived beyond the period of initial contact as the Indians became more and more dependent upon their white neighbors for implements and tools and even for their livelihood. The Death Valley Indians continued to visit the region annually until about 15 or 20 years ago.

The archaeological reconnaissance of Wildrose Canyon was conducted as part of a larger investigation of Death Valley National Monument, sponsored by the National Park Service as part of its program of assessing the archaeological and historical resources of all national parks and monuments. It is being carried on by the Department of Anthropology, University of Southern California. An earlier survey made during the winter of 1952-53 and early spring of 1953 covered a large tract in the northern arm of Death Valley.

The Wildrose Canyon district was selected for archaeological study for 2 reasons. Its accessibility and size made it suitable for a short reconnaissance. Because it was known to have been visited seasonally by the historic Indians, it was hoped that some idea of a seasonal phase of their life could be obtained. The region had not been examined previously though a few

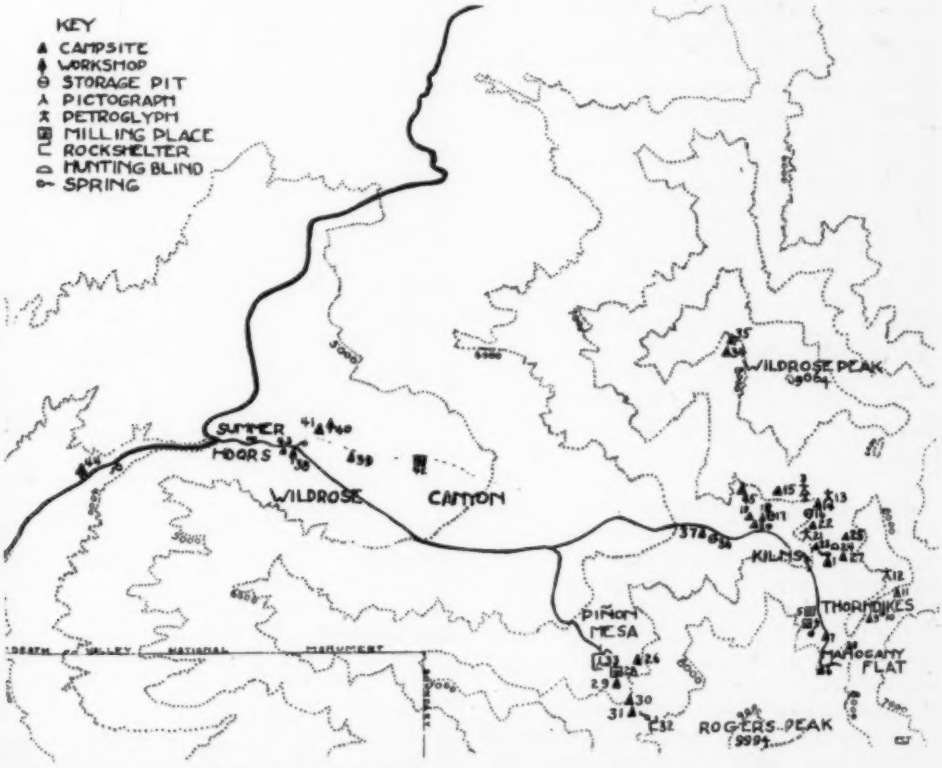

FIG. 104. Map of Wildrose Canyon, with locations of sites.

petroglyph sites had been noted. The survey was made by William J. and Edith (Taylor) Wallace. W. H. Alexander, Floyd and Flora Keller, Dorothy MacArthur, and Harold Packard, all Monument personnel, and Mary Thorndike, also participated in the field work. E. D. Ogston, Matt and Rosemary Ryan, and John Thorndike furnished information on sites. W. H. Alexander, in addition to spending many days in the field, provided photographs of Wildrose Canyon and of several of the sites. The remaining photographs were taken and prepared for publication by Edith T. Wallace.

Field work was begun on August 7, 1953, and continued through August 29. The entire canyon was not covered on foot, as the broken terrain made it impracticable to penetrate some of the most remote places at the heads of a few of the side canyons. Trial surface surveys in the rocky, brush-covered lower valley turned up few remains so large tracts of this were not examined though samplings were made from time to time. The upper valley with its pinyon groves and 2 branch canyons leading off of it were covered exhaustively. Localities which seemed likely to contain archaeological materials, particularly those in proximity to known water sources, were carefully checked.

Archaeological sites, as located, were numbered consecutively with the prefix "WR" (for Wildrose), hence the designations WR1, WR2, etc. Each site as encountered was entered on a record form and, when considered necessary or desirable, photographed and a sketch map made. Extensive surface collections were made at all localities; an attempt was made to obtain as complete a range of artifacts and utilized raw materials as possible.

There was a paucity of archaeological remains in Wildrose Canyon. This can be attributed in part to the devastating effects of erosion. Many traces of habitation have been carried away by flash floods or covered deeply by rock debris. The activity of miners and woodcutters have destroyed some evidences as has recent roadbuilding and other contruction work, particularly in the lower valley.

The general scarcity of prehistoric remains can be explained in large part, however, by the absence of permanent aboriginal settlement. The district was inhabited seasonally by relatively few individuals. Peoples moving frequently and carrying on their backs not only their belongings but also foods procured in different places limited their baggage and carried with them only necessary objects such as baskets used in seed harvesting and weapons. Even the former were often cached to be picked up and used the following season. Local materials were employed for makeshift tools and discarded when no longer needed. While in temporary camps, simple windscreens of brush, which leave few traces, sufficed for shelter (Dutcher 1893: 377).

Forty-five archaeological sites were recorded. These can be classified into 7 categories:

1. *Campsites.* Most numerous were camping places, 30 of which were located. They were usually of small extent, often measuring only a few yards across. None had any depth. Available water supply apparently determined their location as most of them were found near springs. A few were adjacent to dry streams or to mud-lined depressions which presumably retained water for short periods following rainstorms. Several campsites at Mahogany Flat were at least a mile from any presently known water source but the abundance of large pinyon trees here may have compensated for the inconvenience of having to go some distance for water. "House circles" marked most of these sites, usually accompanied by a meager scattering of implements and chips of stone. Shallow depressions containing charcoal were frequent. Animal bone was absent at all except 2 camps. Objects of commercial origin indicated that at least 5 of the settlements were used by modern Indians; the remainder appear to have been entirely prehistoric.

2. *Workshops.* Three sites (WR 28, 40, 44), all in lower Wildrose Canyon, produced no evidence of human presence other than chips of jasper, chert, and obsidian, and were classed as workshops. The number of discarded flakes was few in each case and scattered over a limited area.

3. *Rock Shelters.* Ten rock shelters suitable for human occupation were examined but only 2 contained evidences of utilization by Indians. The first (WR32) was at the top of a steep debris-covered slope 200 yards east of Hummingbird Spring on Pinyon Mesa. A lens of charcoal and ash was visible beneath large boulders which partially filled the shelter. The ceiling was smoke-blackened but not heavily. No artifacts were present on the surface. A second shelter (WR33), somewhat more accessible, was half way up a talus slope just south of the road at Pinyon Mesa. From its position and arrangement it should have been well adapted to the needs of an aboriginal people but it contained no occupational debris. Two of the walls, however, were covered with pictographs and in a narrow cleft toward the rear was a cache containing deer antlers and a basketry seed beater. Small mammal and bird bones were abundant but they appeared to have been carried in by a carnivore (coyote?) which had recently occupied the fissure. A large slab of stone with a pecked area near its center was found at the shelter's entrance.

4. *Milling Places.* Three sets of bedrock mortars were noted (WR 4, 5, 28). None was directly associated with an occupational site though one (WR4) was located only 20 yards from a camp and several stone flakes and a projectile point were collected adjacent to it. A single example of a bedrock milling place (WR42) was observed, on a formation of hard blue slate, almost entirely covered with sand and gravel. Other grinding areas may have been even more completely covered and so hidden from view. Like the mortar holes it was isolated from other indications of human habitation, though a large flat stone with a pecked and slightly concave surface was found nearby.

5. *Storage Pits.* Circular pits, built by making a shallow excavation and throwing out a quantity of loose stones to form a crater-like depression, were observed at several localities (WR 16, 17, 36).

6. *"Hunting Blinds."* Stone walls apparently for the concealment of hunters were noted around a spring (WR24).

7. *Petroglyphs and Pictographs.* Both petroglyphs and pictographs were found, 5 occurrences of pecked figures (WR 2, 3, 12, 13, 21) and 1 of painted (WR33). The rock pictures were scattered at random through the higher mountains and isolated side canyons, in spots quite remote from campsites and springs.

The remains of dwellings were encountered at 17 sites, mostly consisting of "house circles," small cleared spaces of earth banked around with roughly piled boulders. The clearings were made either by picking out each individual stone or by raking the larger stones outward to form the enclosing rim, thus leaving a sandy or gravelly surface. The floors were flat, or in a few cases slightly depressed. The circles normally had an entryway on one side; these were not consistently oriented. In diameter the circles ranged from 6 to 15 feet, averaging between 8 and 9 feet. One had a subsidiary circle about 2 feet across adjoining the main one. These "house circles" probably represent remains of temporary structures designed only for the few days or weeks the people would spend at a food-collecting camp. Originally they probably enclosed walls of poles and brush forming temporary windbreaks of the type constructed by modern Shoshonean groups (Steward 1941: 282). Some may have been sleeping enclosures without any additional construction. Fireplaces containing charcoal and ash were observed in or near the center of 10 circles.

Stone enclosures are a common feature in the arid sections of California. Low rings of boulders were noted at several sites in the Owens Valley to the north (Steward 1933: 334; Riddell 1951: 15) and at a location (Toy 231) in the Panamints (Lathrap and Meighan 1951: 13).

The remains of a large unroofed shelter was still standing near the spring in back of the Charcoal Kilns (WR1). This was about 21 feet in diameter with walls 6 feet high. Pinyon boughs were bound to 4 living trees to form a framework which was covered with various materials — burlap, corrugated iron, and brush. A roughly circular stone hearth was in the center of the structure. The dwelling was occupied seasonally until the late 1930's by Johnny Shoshone, a well-known Death Valley Indian, and his relatives. This is a larger and more complex structure than those constructed in the precontact period. A litter of tin cans, broken glass, and other rubbish surrounded the shelter. The only aboriginal objects recovered from the debris were a fragmentary arrowshaft straightener, 2 obsidian flakes exhibiting "use-chipping," and 2 milling slabs found nearby.

The remains of a second structure were found on the bank of a dry stream in a canyon between the Charcoal Kilns and Pinyon Mesa (WR36). Four juniper trees formed the principal uprights and the back of the shelter. Poles, 4 of which were still standing, had been stuck into the ground to make the front. Thin boughs were passed around the uprights and brush leaned against them to form a wall 3½ feet high. The ground plan was roughly circular, 12 feet in diameter, with an opening facing the stream bed. Large boulders ringed the entire structure. A small fireplace occupied a central position. Three additional stone circles were observed nearby. No evidence of white contact was noted. Ethnographic accounts of the Death Valley Shoshone describe structures identical to these archaeological remains (Steward 1941: 282).

A semicircular windscreen, just east of Thorndike's (WR7), measured 15 by 24 feet and had walls 3 feet high. Poles were planted in the ground between 4 pinyons. Interlocking boughs were laid between the trees and poles and then covered with bunches of Mormon tea and sage to form a fence 3 feet thick. A fireplace of 2 flat rocks near the center of the arc contained charcoal, ash, and bits of charred burlap. This is reported to have been the summer camp of Tom Wilson, a Death Valley Shoshone.

Charcoal-filled depressions, 6 to 10 feet in diameter and about 2 feet in depth, were noted at 8 sites. Unlike house circles they were not surrounded by rocks. The pits contained charcoal, mainly from burned pinyon cones, 6 to 9 inches deep. Green cones were probably heated in these so that the nuts could be more easily removed. This method of obtaining pine nuts has not been recorded for the Death Valley Shoshone (Steward 1941: 231) but was employed by nearby tribes. The cones and sometimes just the loose nuts were covered with coals, earth, and boughs and roasted over night. The nuts were then winnowed from the dirt (Steward 1933: 242).

Five cache pits, apparently for the storage of pine nuts, were found. The best preserved example (WR16) was in a dry stream bed at the base of a steep hill. Circular in form, it was 10 feet in diameter and 3½ feet deep. Its sides were ringed with boulders. Tree limbs set in the ground and strips of juniper bark lined the interior. A stack of pinyon boughs nearby may have once covered the pit. Situated on a high bare hillside was a smaller and shallower hole, 9 feet in diameter and 2 feet in depth (WR17). Pinyon boughs, 6 inches thick, were in the depression and around its borders. Three more pits, 7, 10, and 11 feet in diameter, were found in a line facing an arroyo near the base of Pinyon Mesa. They were round-bottomed with sides sloping to the center and each had been dug to a depth of about 3 feet (WR24). One contained strips of weathered juniper bark. Seed storage in grass- or bark-lined pits was widespread in the Basin. The Death Valley Shoshone cached pine nuts in brush- and stone-covered cavities to conceal them from theft (Steward 1941: 280). The Wildrose examples were probably utilized for this purpose.

Clustered around the spring above the Charcoal Kilns were 3 stone walls (WR24), 2 circular, about 9 feet across with walls 2 to 3 feet high, the third roughly rectangular, 10 feet long with one wall 4 feet high. It is probable that these were booths or blinds for game shooting. A hunter concealed behind one of the walls would have had an unobstructed view of any game animal approaching the spring. The Death Valley Shoshone employed comparable stone blinds for hunting mountain sheep (Driver 1937: 65). Two nearby circular excavations, 6 feet across and 3 deep, also could have hidden waiting huntsmen.

The survey located only a small amount of surface material, mainly stone objects. There was a general absence of bone, antler, and shell items, and only a handful of potsherds and a few objects made from perishable materials were found. The occurrence of the various artifacts by site is summarized in Table 15. The only recurrent items were stone grinding slabs or anvils and chips.

Objects of Chipped Stone. The predominant materials are jasper, chert, fine-grained black basalt, obsidian, and occasionally chalcedony. With the exception of obsidian these materials were obtainable locally either in the Panamint Range or in Death Valley. Obsidian occurs in some quantity at Darwin near the southern end of Panamint Valley and perhaps in small amounts in Death Valley.

Projectile points are the most plentiful and diversified group of flaked items, totalling 56 specimens, whole and fragmentary. Workmanship is uniformly good throughout. Four general forms, all basically triangular, are distinguishable.

1. Expanding stem with square or slightly rounded base, narrower than blade; V-shaped corner notches; pointed tang; average length 3.3 cm.; 7 chert, 2 obsidian.

2. Concave base; U-shaped side notches; short pointed tang: average length 2.7 cm.; 4 obsidian, 1 chalcedony, 1 jasper.

3. Concave base; no side or corner notches; rounded or slightly pointed tang; greatest breadth somewhat below middle; average length 3.1 cm.; 3 obsidian, 1 chert, 1 chalcedony.

4. Square base thinned from both sides; corners somewhat rounded but not notched; average length (estimated) 3.2 cm.; 3 chert, 1 basalt.

Unclassifiable tips and median fragments were also obtained, 15 of chert, 6 of black basalt, 5 of jasper, and 8 of obsidian.

With the exception of the squared-based form, the projectile joints are like those used by historical tribes in the hunting of large game. A corner-notched form has been reported for the Great Basin tribes though with a somewhat concave base (Steward 1941: 221, Fig. 2 *d*). Side-notched projectile tips were employed by the Death Valley Shoshone and other Basin groups (Steward 1941: 290). Driver's Death Valley Shoshone informant (1937: 70) denied the use of this type of projectile point but this seems to be in error. The concave-based point without side or corner notches was also manufactured by recent Death Valley Indians (Driver 1937: 70).

There are in addition 2 specimens which do not fit into any of the above classes. The basal portion of a large jasper point has a broad, shallow basal notch carefully thinned from both sides, deep side notches

near its base, giving it flaring, round-tipped tangs. Its estimated dimensions are 3.2 by 4.3 cm. Another large white chert point, reportedly recovered from a rock ledge above Wildrose Station near the mouth of the canyon, has a deep basal notch and almost straight sides. It measures 3 cm. across and has an estimated length of 5 cm. The size of both specimens suggests that they may be dart rather than arrow tips.

From Thorndike's Camp came 2 large, well-made obsidian blades which presumably served as knives. They were found together at a spot which showed no evidence of human occupation. The first, 8.3 cm. long and 3 cm. wide, has a slightly curved underside which is a plain flake surface. The reverse side is chipped over its entire surface. The slightly concave butt end is thinned from both sides. The second blade is similar, measuring 3 by 7.7 cm. This specimen is flaked over both surfaces. Its base is somewhat concave with a small notch on one side. An unhafted obsidian blade

TABLE 15. DISTRIBUTION OF WILDROSE CANYON ARTIFACTS BY CAMPSITES.

Site	House d.Pole	Windscreens	Charcoal pits	Milling stones	Handstones	Pestles	Projectile points	Blades	Drills	Scrapers	Stone chips	Hammerstones	Potsherds	Pendants	Cauxelan objects
WR1	1			2							X				X
WR6				1			3			2	X				
WR7		1													X
WR9	5			1			7		1	1	X				
WR10	2			1			18	2	2	2	X		1	5	X
WR11	3			1			8	1			X				
WR14	1			1			1								
WR15			1	2							X				
WR18	1			1											
WR19			1	2											
WR20			1	1	1										
WR22	2			3			1				X		2		X
WR23	1		1												X
WR25	1						4				X				
WR26	1										X				
WR27							6	1		1	X				
WR29	1		1												
WR30			1	1	1										
WR31			2	1			1	1		1	X				
WR34	2			2											
WR35	4			2	1		1				X	3	2		
WR37			2	1								1			
WR39	1														
WR41	1			2	2	1									
WR43	1						5	1		1	X		21		
WR45	2			1	1		1			1	X				
TOTALS	30	1	10	26	6	1	56	6	3	9		4	26	3	

used by the Owens Valley Paiute as a "skinning knife" (Steward 1933: 337, Pl. 3 *i*) is almost identical in form. The deliberate thinning of the bases of the Wildrose examples suggests, however, that they were hafted. The Death Valley Shoshone are reported to have used a wooden-hafted stone butchering knife (Steward 1941: 286-7; Driver 1937: 69) as well as buckskin-wrapped blades (Driver 1937: 69).

An obsidian blade fragment with a rounded base was picked up in the road leading up a small side canyon below the Charcoal Kilns. A specimen of jasper, the base of which is missing was also obtained. The slightly concave bases of 2 small blades came from sites WR10 and WR11. A small central section of a chert blade was also recovered at the former site. All are smaller than the pair of obsidian blades described above and undoubtedly were provided with hafts. Three fragments, 2 of obsidian and 1 of chert, are too small to give indication of size or form.

Two slender, sharp-tipped drills, each having a marked widening or flange at one end were found. The first, made from grayish-white chert, has a convex base and is 3.5 cm. long. The other, of variegated chert, has a slightly incurved base thinned by removing small flakes from both surfaces. It measures 3.2 cm. The blades are oval in cross section. Two fragments of similar drills are of pinkish chert and jasper. A broken corner-notched projectile point was converted into a drill or graver by thinning its tip to give a short, sharp point.

Twelve small and irregular flakes of stone, the edges of which have been retouched from one side, are probably scrapers. Only one, collected at Thorndike's, has been secondarily chipped from 2 surfaces. The materials are jasper and obsidian. Their dimensions range from 1.5 by 1.7 cm. to 2.5 by 4 cm. Somewhat larger on the average are 4 retouched chips of black basalt. No preferred shape is noticeable. Most of these could be termed "side scrapers," having been retouched along one edge of the longer axis of the flake. Flakes struck off from cores but not retouched occurred at 20 sites. The majority are of jasper with a smaller percentage of chert, black basalt, and obsidian. A few revealed evidence of temporary usage as scrapers. Chipped cores were rare; only 4 were found.

Objects of Pecked and Ground Stone. Flat stone slabs with pecked surfaces, apparently milling stones or anvils, were numerous in Wildrose Canyon, 36 being noted. Any convenient flat-surfaced stone was utilized and except for a slight amount of pecking near the center, received no further shaping. None showed evidence of heavy wear, though 3 exhibited a slight depression on the grinding surface. For the most part they are moderately thick, angular slabs. A few are thinner and smaller. The raw material was most frequently a hard bluish slate; a white hard-grained sandstone occasionally was substituted. The largest specimen measures 55 by 73 cm. and is 13 cm. thick; the smallest is 15 by 23 cm. and 4 cm. thick. Average dimensions are: length 45 cm.,

width 34 cm., thickness 11 cm. Though some of the specimens were probably employed as milling stones, the majority may have served as anvils for dislodging pine nuts from cones or for shelling them (Dutcher 1892: 378). The mealing slab is used throughout the Great Basin for grinding seeds, including pine nuts (Steward 1941: 230). Pounding is often done on the back of the stone.

The most impressive feature of the handstones is their small number, all told only 7 specimens, whole and fragmentary. They are somewhat variable in shape and size, usually between oval and rectangular in outline. Five are uniface with one flat grinding surface and a convex upper surface. The remaining 2 are biface with 2 smooth and evenly utilized surfaces, and rather flat in cross section. All exhibit a well-worn grinding face. They were manufactured from a hard, fine-grained sandstone. The uniface specimens average 9.5 by 13 cm. and are 5.5 cm. thick. The bifaces are somewhat smaller and thinner with dimensions of 8 by 10.5 cm. and 4 cm. in thickness. Oval mullers were used with a back-and-forth movement by the Death Valley Shoshone (Steward 1941: 287) and other Basin peoples.

Only 4 pestles were found. One, from Thorndike's, was a median section of a carefully-shaped specimen, rounded by pecking and smoothing and slightly flattened on 2 sides giving an oval cross section, 3 by 5 cm., tapering toward one end. It is probably part of a conical pestle. Somewhat similar in form, but smaller, is an example from WR41. A hard, bluish granitic stone was used for both pestles. A rough angular stone with a rounded base was obtained adjacent to some bedrock mortar holes (WR5). It is of hard brown schist and was put to use without any attempt at shaping; it is 30.5 cm. long and 10.7 wide. An elongated, roughly conical cobble, 35 cm. long and 7.5 in diameter, apparently utilized as a pestle, was picked up in a dry wash in lower Wildrose Canyon. It has a somewhat long and tapering tip, the wear on which is such as might result from use in a wooden mortar. Natural as well as shaped stones were employed as pestles by the Death Valley Shoshone (Driver 1937: 68), particularly for the pounding of dry mesquite pods in a wooden mortar (Coville 1892: 355).

No portable mortars were found, though bedrock mortar holes were encountered at 3 sites. The first (WR4) consisted of a single grinding hole on an isolated boulder; the second (WR5), on a schist outcrop, had 2 well-defined depressions and 2 incipient ones. Both sites were at Thorndike's Camp not far from the spring. The last milling place (WR28) at Pinyon Mesa consisted of a single pit on an outcrop of hard whitish sandstone. In cross section the mortar holes were cup-shaped with rounded bottoms. Depths were shallow, from 3 to 9 cm.; top diameters ranged from 7.5 to 16.5 cm. None gave indication of extensive usage. Bedrock mortars are not particularly characteristic of this general region, portable wooden mortars being commonly used instead. At least some of the Death Valley Shoshone appear to have utilized bedrock mortars occasionally (Driver 1937: 68). Steward's Death Valley Shoshone informant denied that bedrock mortars were employed (1941: 286-7). A few sets of mortar holes have been observed in the valley itself. The single bedrock milling stone (WR42) consisted of a pecked and worn area on a formation of hard blue slate. It covered an area 10 by 17 cm. Sand and gravel washed down from a nearby hillside and covered most of the outcropping. Other grinding spots may have been present but are now obliterated.

Approximately one half of an arrowshaft straightener was found at WR1, of dark steatite, with a single transverse groove, though it may originally have had 2. It is slightly oval in outline with a flat base and rounded upper surface. A crosshatched design cut into the soft stone almost covers the upper surface. The specimen must have measured 2.5 by 9 cm. It is 1.9 cm. thick. The Death Valley Shoshone employed a "one-piece stone" straightener for cane arrowshafts. It was heated and the cane was pressed into the groove until it was hot. The cane was then straightened by holding it crosswise in the teeth and drawing the ends downward (Coville 1892: 360). A 2-grooved specimen was found near Stovepipe Wells in Death Valley (Steward 1941: 338, Fig. 3 *g*, *h*).

Objects made for personal adornment were very scarce in Wildrose Canyon. Three incomplete pendants made from thin plates of soft, fine-grained steatite were collected at WR10. Apparently all 3 are rejects discarded when broken during the process of manufacture. They are roughly rectangular in outline with rounded corners. A perforation for suspension was drilled from one surface near one end. Size estimates for the 2 more complete specimens are 1.2 by 2 cm. and 1.3 by 2:2 cm. A complete pendant of greenish slate was found at Mahogany Flat (adjacent to WR6). It has an expanded base and rounded upper end, a biconically drilled hole 5 mm. from the upper border, and the lower margin serrated with 4 indentations. An incised design consisting of 4 irregularly spaced vertical lines intersected by 3 horizontal incisions covers one surface. Faint vertical lines are visible on the reverse side. The specimen is 6.5 cm. long and 3.3 cm. wide at the base. Comparable pendants have been collected in Death Valley though they have not been reported for the modern Indians.

Two unshaped plates of bluish slate bearing incised designs were found near Mahogany Flat (WR15). The first piece, 4.6 by 9.7 cm., has the outline of what appears to be a dome-shaped structure cut into it. The other, 5.5 by 6.2 cm., bears simple incised lines over its entire surface. The edges are unmodified and there is no perforation or other indication of a method of attachment which would permit the objects to have been worn as pendants. The use to which these specimens was put is unknown. A slate tablet with simple incised geometric designs was obtained at a site (Iny 226) on the ridge of the divide of the Panamints farther to the north (Lathrap and Meighan 1951: 24). Almost

identical are 3 examples from the Coville Rock Shelter (Meighan 1953: 184-5), 2 of them painted red on both sides.

Objects of Unworked Stone. Recognizable hammerstones are few in number, totaling 4 in all. These are oval quartzite pebbles slightly abraded or battered on one or 2 ends. They were selected only for convenience of size and have no specialized form. They vary in length from 9.5 to 14 cm.; in width from 5 to 9.5 cm.; and in thickness from 4 to 4.5 cm. One muller was also employed secondarily as a hammer. Simple cobble hammerstones were used by all the Basin peoples, including the Death Valley Shoshone (Driver 1937: 70).

Pottery. During the survey 26 fragments of pottery were collected, 1 at WR10, 2 at WR22, 2 at WR35, and 21 at WR43. The latter seem to be all from one vessel. The quantity suggests that pottery containers were not regularly transported to pine-nut camps, perhaps because of their fragile nature. The sherds are all small and give no clue as to vessel size or form. In thickness they vary from 3 to 8 mm. On the outside surface, the potsherds are brown. Within, the color is somewhat darker ranging almost to black on some examples. The vessels are of coarse, granular ware, with one specimen retaining faint traces of coils on the interior. The walls were thinned and smoothed by scraping; there is no indication of use of the paddle and anvil. The clay is rather heavily tempered with sand. Minute flakes of mica and grains of quartz and feldspar are included though not in quantity. No attempt at decoration is visible.

The sherds resemble closely the coarse pottery of the Great Basin. Their scant number makes specific correlation unreliable. They fit easily into the range of variation of either Southern Paiute Utility ware (Baldwin 1950: 53-4) or Owens Valley Brown ware (Riddell 1951: 20-3), with more resemblances to the latter. These 2 pottery types are quite similar and intergrade one into the other. An analogous ware has also been collected at Deep Springs Valley, east of Bishop in Inyo County (Steward 1928: 348). The Death Valley Shoshone manufactured a similar if not identical pottery (Steward 1941: 294; Driver 1937: 80).

Objects of Perishable Materials. Conditions in Wildrose Canyon were not particularly favorable for the preservation of items made from perishable materials. Two long poles stripped of their bark were found leaning against a pinyon tree at WR20. They were about 8 feet long and crudely severed at either end. These may have been employed in knocking cones from the trees. The Death Valley Shoshone used a straight pole for this purpose (Driver 1937: 63) as well as a hooked one (Dutcher 1892: 378; Steward 1941: 231).

Adjacent to site WR8 near Mahogany Flat a weathered wooden object was found which may be an arrow bunt originally set in a cane shaft. It has a tapering shaft 17 cm. long and an expanded cylindrical head 11.5 cm. long and 1.5 cm. in diameter. The butt end is cut off square whereas the tip is somewhat rounded. It is made of mountain mahogany. The Death Valley Shoshone and other Basin groups used plain wooden arrowpoints with 4 cross sticks for stunning birds (Steward 1941: 250). The expanded head of the Wildrose specimen, though heavier, could have had a similar function.

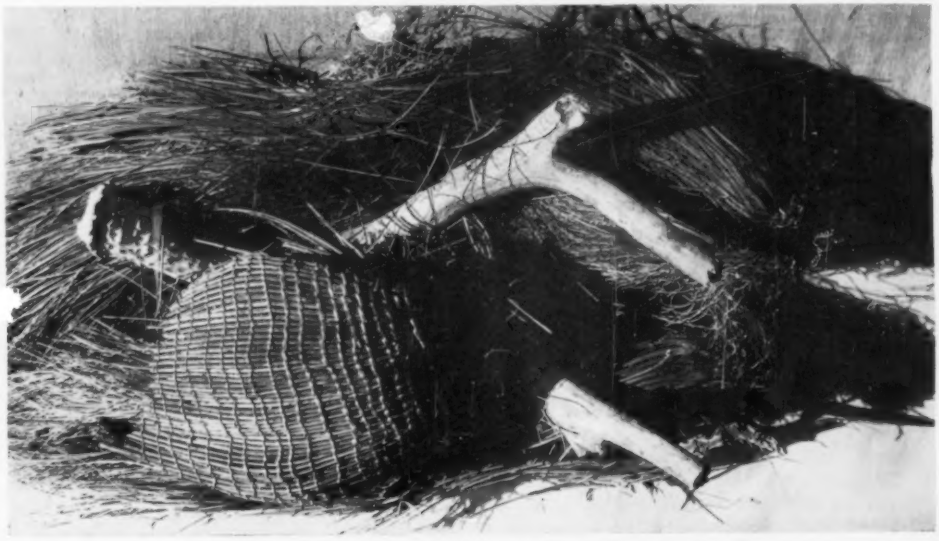

FIG. 105. Cache from rock shelter WR33, Wildrose Canyon.

A paddle-shaped object cut from a barrel stave was found near WR9. This could have been used for striking pine nuts from ripe cones. The paddle measures 11.5 by 42.3 cm.

The only textile specimens, a basketry seed beater and a portion of a tule mat, came from a neatly arranged cache immediately below the surface in rock shelter site WR33. The cache consisted of a covering of shredded cedar bark under which was the basketry specimen, a mat fragment, and a set of deer antlers lying upon a thick bed of grass (Fig. 105). The seed beater is the familiar type used by Basin tribes, including the Death Valley Shoshone, to knock small seeds into a gathering basket (Coville 1892: 353; Driver 1937: 77; Steward 1941: 292). The specimen has parallel warps of thin, peeled willow twigs held together by rows of twining 5 to 1 cm. apart. Stitches lean downward to the left. The weft material is split willow. The ends of the warps are cut off square and a double row of twining about 1 cm. from the upper edge gives added strength. The base of the seed beater is cut or broken away so that overall length cannot be determined. It measures 18 cm. across and is 5 cm. deep.

The small fragment of matting is made from unmodified tule stems laid side by side and held together by rows of twining. The wefts consist of 2 strands of twisted tule.

Miscellaneous Objects. The set of mule-deer antlers from the cache is of particular interest as neither deer nor antelope has been reported as living in this region (Grinnell 1937: 168).

A single badly-weathered fragment of freshwater mussel shell was found at WR27. This would, of course, represent an import, perhaps from Owens Valley where many sites along the Owens River contain a considerable quantity of mussel shell (Riddell 1951: 19).

Two opaque, light blue glass trade beads were picked up at WR10. They are short cylindrical tubes 3 mm. long and 2 mm. in diameter with irregular ends. The perforation measures slightly less than 1 mm. The presence of glass beads does not necessarily imply white contact as strings of glass beads seem to have reached this district in precontact times from Indians to the south (Steward 1938: 45).

Petroglyphs and Pictographs. Of the rock pictures, pecked figures are by far the most numerous. Although fairly large rock masses with vertical faces were available, the prehistoric people selected small isolated boulders or flat outcroppings for their petroglyphs. A dark reddish brown metamorphic slate was most frequently selected though one set of designs was on a slab of hard bluish slate. The representations were made by pecking away the darkly-weathered surface ("desert varnish") of the rock to give a contrast between figure and background. In most instances the peck marks are large, though at WR2 the pits are small and delicate giving an almost incised appearance. The figures are small and relatively simple. The badly weathered condition of a few of the elements made it difficult to determine accurately what they represented. In most cases, however, the designs were easily recognizable. Most of the figures are of a geometric nature; a few distinctly life forms. The individual elements present are:

1. Mountain Sheep. This is the only mammal species distinguishable and is depicted twice. The characteristic recurved horns made them easily recognizable. The mountain sheep is perhaps the commonest naturalistic representation in the Basin region.

2. Human Figures. Humans are represented twice. A well-executed pair (WR2) consists of a costumed male and female figure. They are highly conventionalized with squared shoulders.

3. Snakes. Snakes were pictured twice. They are merely wavy lines so that no species is clearly recognizable. Two were found, the head on one definitely enlarged, a simple circle attached to the body.

4. "Sun Disk." A circle with lines radiating from it was noted at one site (WR21). The figure probably is a pictorial representation of the sun.

5. Simple Geometric Figures. A variety were noted, vertical lines or combinations of these, circles, wavy and zigzag lines, crosses, and dots. A single example of a circular gridiron figure, essentially a circle filled with straight lines, was observed.

6. Complex Goemetric Figures. Several rather elaborate but rambling curvilinear designs occur (WR 1, 2, 21). These are often referred to locally as "maps." That this is the explanation is very doubtful.

There is no good clue to the authorship or antiquity of the rock-cut figures. The modern Death Valley Shoshone are not known to have inscribed or painted designs on stone and generally attribute their occurrence to a supernatural being (Driver 1937: 36). The main group at WR2 appears to be of more recent origin than the others. The fresh appearance of the pecked marks as well as the lack of coloration due to weathering suggests this. Also they have been chipped over an earlier and cruder geometrical group. The remainder of the abraded designs are discolored by weathering, almost to the point of obliteration. Desert varnish, a peculiar oxidation that slowly coats rocks, overlies some of the figures; others are badly eroded. Such changes would seem to indicate some antiquity. The designs, though simple and relatively few in number, are unmistakably similar to those of the Great Basin, a region characterized by an abundance of pecked rock figures (Steward 1929: 219). Many of the elements are duplicated in other sections of western North America as well.

Painted ornamentation was observed at only one site (WR33), a rock shelter. The side walls of this provided a good working surface as they were fairly smooth. Designs were painted on the east and west walls at the entrance. Those on the west have suffered less from weathering and are a deep red; the remainder have faded to a pale orange. Exfoliation of the rock surface

since the pictographs were made, combined with fading, has reduced some figures to a vagueness which makes identification of the subject impossible. The most frequent of the recognizable elements are conventionalized human forms with somewhat squared and exaggerated shoulders. Their arms and legs are shown in several positions, generally outstretched or akimbo. Isolated legs and arms and portions of human torsos also occur. "Bird tracks" consisting of 3 radiating lines above a vertical one make up the only other designs. All of the painted design elements are duplicated in the Basin and southern Californian regions (Steward 1929).

Wildrose Canyon and the neighboring mountains were too rugged and too limited in food-collecting opportunities to have attracted any great numbers of Indians. The Death Valley Shoshone inhabited the region seasonally and very sparsely in recent times. Evidently this section was always lightly settled as archaeological sites are few and none give indication of extended or repeated occupation.

The artifact inventory is a short one and from the archaeological record the material side of life would have to be described as extremely simple. It should be kept in mind, however, that temporary occupation of this type does not leave a complete range of implement forms. More permanent campsites in Death Valley produce a wider variety as well as a greater abundance of artifacts.

The vast majority of the archaeological materials collected in Wildrose Canyon can be matched with ethnographic specimens (Table 16). Actually the number of parallels may be greater than indicated as ethnographic information on such objects as knives, arrowpoints, drills, scrapers, and the like is unreliable because these things were quickly supplanted by objects procured from Caucasians. The campsites from which the specimens came can be safely attributed to the modern Indians or their immediate predecessors. The presence of trade goods indicates a relatively recent date for some.

There are a few items which hint at earlier occupation or visitation. Two projectile points, distinct in size and form from those of the recent people, may have been left by wandering hunters at an earlier date. At least some of the petroglyphs have the appearance of being fairly ancient.

TABLE 16. CULTURAL COMPARISONS OF WILDROSE CANYON ARTIFACTS.

Wildrose Canyon Sites	Death Valley Shoshoni	Coville Rock Shelter	Site Iny 2 Owens Valley
Flaked stone projectile points	X	X	X
corner notched	X	X	X
concave base, side notched	X		X
concave base, unnotched	X		X
square base		(X)	X
Flaked stone blades	X	X	(X)
square or slightly concave base	X		(X)
convex base		X	
Flaked stone drills			X
expanded base			X
Flake scrapers	X	X	X
amorphous	X	X	X
Milling stones	X	X	X
slab	X	X	X
bedrock			X
Handstones	X	X	X
oval or rectangular, uniface	X	(X)	X
oval or rectangular, biface			X
Bedrock mortars	(X)		X
Stone pestles	X		X
shaped, conical	X		
unshaped cobbles	X		X
Stone arrow straightener	X		
Stone pendants	(X)		X
Incised slate tablets		X	
Pottery	X	X	X
coarse brown ware	X	X	X
Hammerstones	X		
unmodified cobbles	X		
Twined basketry seed-beater	X	X	
Glass trade beads	X		X

X - Trait present
(X)- Trait probably present

The Panamint-Death Valley region is virtually unknown archaeologically so there is scant comparable material. The Coville Rock Shelter (Iny 222) and the historic Paiute winter camp in Owens Valley are the only nearby sites described in any detail.

The Coville site, a small rock shelter in one of the numerous Panamint Range canyons, contained mainly perishable materials, items generally absent in Wildrose campsites. This makes direct cultural comparison somewhat difficult and unreliable. Among shared traits are house circles, cache pits, seed beaters, handstones, milling stones, convex-base blades, simple flake scrapers, incised slate tablets, and coarse brown pottery. Stone points for arrows were relatively scarce in the rock shelter but 2 of the Wildrose forms, square or convex based and corner notched, were present. The Coville locality, like the Wildrose campsites, represents a temporary stopping place for small groups of people moving from one food-collecting district to another. The shelter occupants were also satisfied with meager necessities and used simple makeshifts which were abandoned when no longer needed. An exceedingly small amount of pottery, 2 sherds in all, was recovered.

The Owens Valley locality (Iny 2) is much more extensive. It is an historic Paiute winter village of large size with numerous house pits and bedrock milling places. Excavations produced a wide variety of artifacts. Items duplicated in the Wildrose collection include milling stones, handstones, bedrock mortars, slate pendants, flaked stone drills with expanded bases, glass trade beads, and pottery. Shared projectile point classes include corner-notched, side-notched with concave base, concave-based with no notching, and square-based. The large quantity of sherds, the scarcity of portable mealing slabs, and the absence or scarcity of flaked stone blades distinguishes Iny 2 from the Wildrose sites.

The Wildrose material resembles most closely that from Iny 2 (Table 16). Actually this may be more apparent than real, as the richer cultural inventory from the Owens Valley site allows greater opportunity for cultural comparison and correlation than does the rather meager array from the Coville rock shelter. Also, a time difference may be involved, as the Coville site is regarded as belonging to a somewhat earlier period. Both the Owens Valley collection and that from Wildrose belong essentially to the historic phase of Indian occupation.

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THE ARCHAEOLOGICAL DELINEATION OF A CULTURAL BOUNDARY IN PAPAGUERIA *

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THE AREA dealt with in this report is that portion of northwestern Sonora and southwestern Arizona bounded on the southwest by the Gulf of California, on the west by the Colorado River valley below the junction of the Gila River, on the north by the Gila River valley, and on the east by an imaginary line from the vicinity of Gila Bend south along the western edge of the Papago Reservation and thence southwest to the mouth of the Sonoyta River on the Gulf of California (Fig. 106). Within this area Sauer has suggested a boundary between the Piman-speaking people of southern Arizona and northern Sonora, and the Yuman-speaking tribes of the lower Colorado and Gila River valleys, based on linguistic affiliations described in early historical sources (Sauer 1934, map). On archaeological evidence Gifford has suggested that the locality between Punta La Cholla and the mouth of the Sonoyta River represented a point on an ethnic boundary (Gifford 1946: 221). Recent archaeological, historical, and ethnological research has provided more information, making it possible to suggest a relocation of the linguistic boundary and an extension and clarification of the boundary hypothesized by Gifford.

The river valleys, where agriculture was possible, have been excepted from this study, which has been limited to this northward extension of the Sonoran desert. Its predominant characteristic is scarcity of water, which is generally found only in the natural rock tanks (*tinajas*) in the mountains, although a few permanent springs are known. The outstanding topographical features are the extinct volcanic area known as the Pinacate, extending from near Punta Peñasca northward across the international boundary, and the area of sand dunes generally referred to as the *médanos*, which occupy most of the Sonora part of the region from the west side of the main mass of the Pinacate north and west. Except for fish along the coast, the area is, and, judging from the early accounts, was, about as devoid of food as of water. Saguaro is plentiful only in the mountains along the eastern side of the region, and the pitahaya (organ pipe cactus) has an equally limited distribution in the southeast portion. Mesquite, which is plentiful in places now, may not have been so before the increase of cattle in the country in recent times; old people in Sonoyta have pointed out thick groves which have grown up within their memories. Although desert mountain sheep were once more plentiful than now — Mange (1926: 253) reported them in quantity as early as the end of the 17th century — they could hardly have been a food staple, owing to the difficulty of securing them in that terrain with the means at the Indians' command. Actually, the Indians who occupied the region probably ate anything they could get, as witness Mange's account of those met at the Pinacate (1926: 286).

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In 1947 I began collecting from sites scattered over this area, and in the winter of 1951-52 the National Park Service made it possible for me to spend 3 months surveying intensively in the Organ Pipe Cactus National Monument south of Ajo and analyzing the material. Since then additional short trips to parts of the region I had not previously visited have yielded collections from most of the area, and E. W. Gifford kindly allowed me to study his material from the region, on which he has not yet reported. Concurrently with the survey I have attempted to locate and consult every available historical reference which contains ethnographic data for that part of the country.

My archaeological interpretations are based primarily on ceramic evidence. Archaeologists in the Southwest are frequently criticized for their preoccupation with potsherds, and sometimes accused of ignoring other evidence. Anyone who has worked in this part of the Southwest knows that there is frequently little else left except pottery in the way of evidence. Architecture is of little use; the only structures found, and they are not common, are small stone enclosures, averaging about 6 feet in diameter, rarely more than one or 2 courses high, with no other features at all. They are all that remains of the rock and brush windbreaks erected as recently as 50 years ago by the Indians (Celaya, personal communication; Russell 1908, Pl. 6*b*; Lumholtz, 1912: 233), used in early historic times not only by most of the tribes of the Gila-Sonora and Baja California regions (Treutlein 1949: 192; Baegert 1942: 78) but as far north as the Great Basin, where Dobyns found them among the Walapai (personal communication) and Kelly (1932: 106) reported them for the Surprise Valley Paiute. They are also found archaeologically in the California deserts (Rogers 1939, Pls. 2*a* and 10*b*), in Walapai country (Dobyns, personal

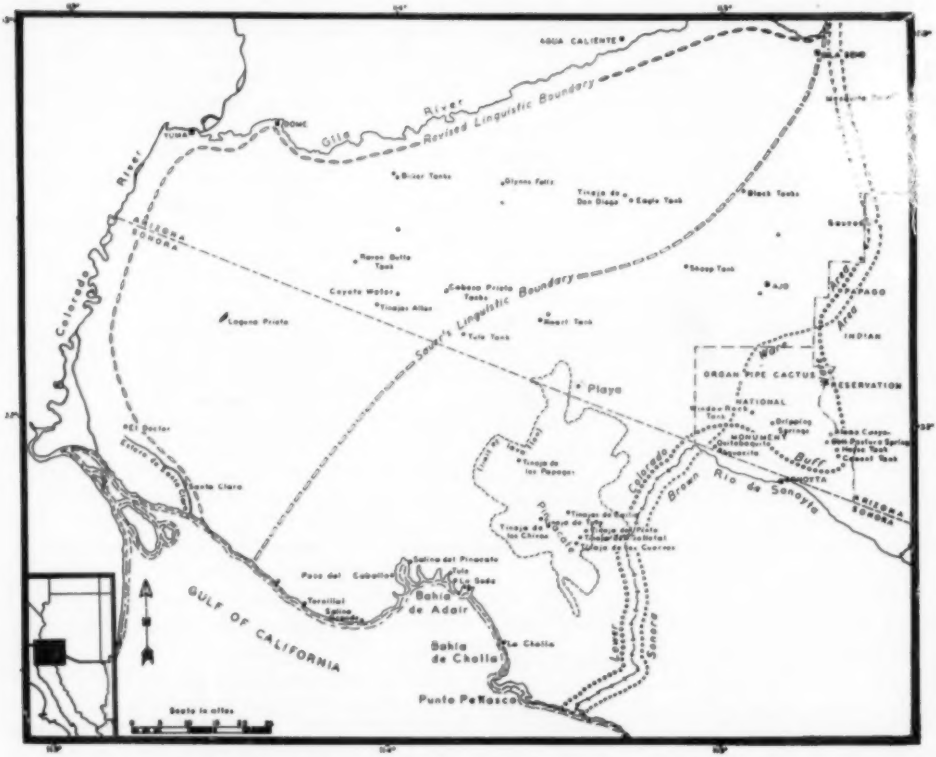

FIG. 106. Linguistic and cultural boundaries in northwestern Papagueria.

communication), and in the territory of the Owens Valley Paiute (Steward 1933: 72, 267, Pl. 2*b*). Except for the larger, and perhaps more substantially built, communal dwellings of some of the Colorado River tribes, I doubt whether it would be possible to identify, on architectural features alone, the group within this area to which the archaeological remains of this wikiup type of structure should be assigned. The other archaeological evidence is likewise so generalized as to be inconclusive. The only distinctions apparent thus far are in the use of shell and possibly in burial customs. In the Yuman part of the area shell is scarce almost to nonexistent, and is even more rarely found in worked form; in the Piman section it is abundant in both worked and unworked form. There is insufficient evidence to warrant conclusions regarding burial customs — traces of cremations in 2 sites, 2 inhumations from other sites, and the latter type of burial reported for a Piman group near Somerton, Arizona (Gifford 1933: 262).

In analyzing the pottery I have been forced to seek usable labels. Schroeder (1952: 7-35) has provided the term "Lower Colorado Buff Ware" for pottery coming from the lower Colorado–lower Gila valley area. For the pottery which is in the Sonoran tradition of red or brown (Kelly 1944: 206), rather than gray or buff as is the case with the Colorado River pottery, I have used the term Sonora Brown Ware, for lack of any previously published general designation. Under both wares a number of types can be subsumed, following Colton and Hargrave's system of pottery classification (1937: 1-5). The types of Lower Colorado Buff Ware are described by Schroeder (1952); those of Sonora Brown ware by Sauer and Brand (1931: 107-9; Brand 1935: 298-9), Scantling (1939: 11; 1940: 27-38), Withers (1941: 28-56; 1944: 40-2), and Haury (1950: 343-53). As many of those types are imperfectly known I have thought it better to attempt to go no farther than identification of ware in many cases. The *wares* are easily distinguished on even a casual inspection and it is the ware, not the individual type, which is important for the theme of this study.

Analysis of the ceramic material shows that sites located to the north and west of the channel of the Sonoyta River in Sonora and of a line drawn from near Quitobaquito, where the river abruptly changes direction, north through the Ajo Valley in the Organ Pipe Cactus National Monument to a point east of Ajo approximately on the western edge of the Papago Reservation, beyond which point I have as yet no data for extending it, bear pottery which is predominantly Lower Colorado Buff Ware. By predominantly is meant that 80 percent or more of the sherds collected are of one ware. The exceptions in this area are locations around the playa near the northern edge of the Pinacate lava flow, where sites on which Hohokam Buff Ware (Colton 1941: 46) predominated were found. As the question of Hohokam history is not a part of the problem being dealt with here, those sites, as well as other Hohokam sites in the area, are excepted from this study. To the southeast of this line, which properly should be described as a zone, the pottery was as uniformly Sonora Brown Ware. Not that sherds of either ware were not found in the area of predominance of the other; Papago Black-on-red and Trincheras Purple-on-red (types of Sonora Brown) were found at sites on the Pinacate, at Cholla Bay, and west of the playa, and I have seen Lower Colorado Buff Ware types, for example, Tumco Stucco, at sites as far east as Estacion de la Playa in Sonora and the Santa Cruz Valley. Nevertheless, the ceramic picture on either side of that zone is one of a high degree of homogeneity, especially on the western side, and the difference on each side of the zone is quite apparent, except in the Ajo Valley. Here, the boundary is apparent more in the evidence of mixture than in the ceramic differences seen elsewhere. "Pure" sites occur adjacent to each other; sites with a mixture of wares, between 20 and 50 percent of each in the same site, are found; and some of the pottery itself exhibits an apparent mixture of the characteristics of the 2 wares. In addition there is in this area a heavy occurrence of a Hohokam Plain Ware (Wingfield Plain, Colton 1941: 45-6) to further blur the dividing line. Schroeder (1954: 103-7) offers evidence that Wingfield Plain, heretofore reported only as an intrusive where found, originated in the Agua Fria drainage, although there seems to be some doubt as to what culture affiliation it represents. Its presence within the area of this survey in such quantity as to preclude its being regarded as an intrusive was only learned after his paper had left his hands.

Because the time ranges, particularly for the types of Lower Colorado Buff Ware, are as yet

either so little known or so broadly sketched out, I cannot draw any chronological implications. It might be argued that the differences between the 2 ceramic areas reflect temporal differences, but the ceramic homogeneity and the occurrence of the same decorated types in both areas, however scarce, opposes any assumption other than that occupation of both was simultaneous.

On the basis of the distribution just described I feel justified in extending Gifford's postulated boundary along that zone of difference. Before making any statement as to the possible significance of that boundary let us examine the historical evidence. To cite only one of the several statements in his accounts to the effect that the inhabitants of the area were Piman, in 1698 Kino (1922: 404) made contact with Indians living in the Pinacate area who told him that they occasionally visited their Pima relatives to the northwest on the other bank of the Gila. In 1699 Mange (1926: 265) met Yumas and Pimas on the Gila only 3 leagues above the junction of the 2 rivers. In 1750 Sedelmayr reported that the "small mountains" betweeen Sonoyta and the junction of the Gila and the Colorado rivers were peopled by a few gentile Pimas. Garcés in his account of his journey west from San Xavier del Bac in 1771, stated that the Papagos of the country north and west of Sonoyta, who were allied with the Pimas Gileños, would have joined in the 1751 revolt had not the latter abstained from the conspiracy. He added, "Those people resemble Yumas in their customs, although in reality they are Pimas. . . ." Three years later both Anza and Diaz (Bolton 1930 Vol. 2: 17-30, 260-2) noted that the people occupying this part of the country were Papagos, and Diaz gave details of their economy. During the 9 months he spent at the junction of the rivers while establishing the Yuma missions in 1779, Argüello gathered accounts of surrounding tribes, although he evidently did not travel through the country. On the Sonora side and neighboring the *Jalchedunes* were found ". . . another tribe called the *Pimas de las Arenas*, who, according to the news, are situated in some *meganales* [*medanales* or *médanos*, sand dunes], who joined the Yumas in the cited revolt" of 1781, in which the Yuma missions were destroyed. Gray (1855: 20-1), in 1854, identified the people he met around Adair Bay as "Papigos," and noted that toward the head of the gulf the Papagos were "mixed up with the Cocopas." Michler's description (Emory 1857 Vol. 1, Pt. 1: 123) of the Sand Papagos 3 years later may well have been taken from Gray's report, for there is nothing in his account to indicate that his party actually met any Indians between the present Papago country and the Colorado. An 1860 account quoted by Hodge (1910: 431) identified the Indians around Sonoyta as Sand Papago or *"Papagos Arenanos"* [sic], as the local people called them, ". . . . from their frequenting . . . the wild wastes . . . along the shores of the Gulf of California. . . ." Pinart visited a group of Sand Papago in the dunes west of the Pinacate in 1878 and noted that they spoke a dialect but little different from the rest of the Papagos, the difference consisting mainly in pronunciation and the use of a few words which dealt with specialized features of their environment. In 1894 Gaillard (p. 293) described the Papago as occupying the country as far west as the 114th meridian in Arizona and south and west of that area in Sonora. As a result of his 1909-10 explorations in the region, Lumholtz (1912, map) recorded the locations of former Sand Papago camps. Gifford (1933: 262) reported the former presence of a small band of Sand Papagos near Somerton, Arizona, which used to visit the Sonora gulf coast, and were friends of the Yumas; he also visited Sand Papagos now living near Dome, Arizona (personal communication). Alberto Celaya, who was Lumholtz's guide and is performing the same service for us, has given considerable information in addition to that contained in Lumholtz, both from his own experience and from accounts given by his father and uncles. Although he stated that the *Areneños* frequented the médanos, fleeing there when menaced by posses of ranchers whose establishments the Indians had raided, and visited and traded with the Yumas, he believes that the Cocopa had been the ones who frequented the Laguna Prieta and left the Tumco Buff sherds, the only type that we found on our visit there. On the other hand, Harner's description (letter to Gifford, April 8, 1954) of Cocopa pottery in the Museum of Anthropology at Berkeley, opposes the assumption that Tumco Buff was a Cocopa pottery type, at least within the last half century or more. Celaya and other informants have stated unequivocally that the Areneños made their own pottery, and the service pot-

tery from known Sand Papago camps compares very closely with type sherds of Palomas Buff. Among the Yuman customs noted by Garcés for the Piman-speaking people of the region may have been the Yuman ceramic tradition; the fact that the decorated types found at these sites are usually of Sonora Brown ware suggests the situation such as that among the Sinagua (Colton 1946), wherein a group made its utility pottery but imported its decorated vessels. Old people among the Gila River Pimas know of "a kind of Pima, who lived between the Papagos and the ocean, in the sand," the *hiatak kuá'agum*, literally "sand root eaters," in reference to the tuber, *Ammombroma sonorae*, eaten by the Sand Papagos and described by Gray and Lumholtz in the works cited. One old man had visited them at Dome, and said they could understand each other, but they "talked kind of different, but it was Pima all right" (Kisto Morago, personal communication). Robert Thomas (personal communication) has obtained from those at Dome tribal locations which include many of the sites within the area, some of which I had already tentatively identified as Sand Papago camps on the basis of the archaeological evidence.

A few statements may be taken as conflicting with the evidence that the sole inhabitants of the area were a Piman group. Froebel (1859: 524) met Cocopa in the vicinity of Painted Rocks on the lower Gila, on their way to invite the Pimas Gileños to go fight the Yumas, and Gray's statement in the same year regarding the mixture between them and the Sand Papagos around the head of the gulf has already been given. As Gifford (1933) showed that the customary route followed by the Cocopa on a journey to the Maricopas of the Gila was overland across the angle of the lower Colorado and the Gila, as well as giving locations for them on the coastal mesas of Sonora (Gifford 1933: 261, but the location of Kwurksispeuwahan is not clear), presumably the party met by Froebel was following an established route through the northwestern portion of Sand Papago territory. Except for Celaya's statement given above concerning Laguna Prieta, however, there is little reason to believe that the Cocopa even travelled, much less lived, over any appreciable part of the region outside the northwestern periphery. The great majority of the historical evidence shows that the people in this region where the sites bear Lower Colorado Buff Ware were a branch of the Piman family, although at least 2 sources state or imply that (except for language) their culture was more Yuman than Piman. Garcés, Argüello, Gray, Lumholtz, Gifford, and Celaya all have the Sand Papago in friendly contact with at least one Yuman group, the Cocopa, the Yuma, and/or the Halchidom. Under such circumstances it should not be surprising if Yuman cultural elements had been taken over by them.

On the foregoing bases I suggest that the linguistic boundary proposed by Sauer be shifted northward and westward to include little more than the actual bottom lands of the lower Gila and Colorado rivers within the Yuman territory (Fig. 106), and for reasons given below, I would offer the possibility that the Piman territory might actually have extended north across the Gila between Agua Caliente and the junction. When Oñate came down the Colorado in 1605, his party found a settlement of Indians at the junction of the 2 rivers, of difficult speech and with dress and hair style different from all the others on the river, the *Ozaras*, whose territory was said to extend to the sea (Zárate Salmeron 1856: 34-5). Kroeber (1925: 802), because of the linguistic difference, identified them as ". . . at least some Piman division, who then lived farther down the Gila than subsequently." His perception is born out by Escobar's identification of their language and dress as being similar to that of the Tepehuanes (Hammond and Rey 1953: 1020), a Piman-speaking group he had met in northwestern Mexico (Mason 1917: 312; Kroeber 1934: 3). The distinctive manner of wearing the hair tied up and bound around the head, instead of loose as among the other Colorado River people, which Escobar and Zárate Salmeron described for the Ozaras, was evidently a Piman characteristic. It was noted by most of the early travellers along the Gila, for example, Font in 1775 (Bolton 1930 Vol. 4: 49), Johnson in 1846 (Emory 1848: 602), Bartlett in 1852 (1854 Vol. 2: 229), and by Pinart for the Sand Papagos. It is doubtful that the Ozaras could have been the Western Yavapai. It has never been suggested, to my knowledge, that the Yavapai territory extended to the sea. Furthermore, the expedition had just passed through Yavapai territory, and should have recognized them had they again met a group this far downstream, nor would

they have been likely to note them as of different, and difficult, speech from the Yuman-speaking groups they had already met on the river had they been Yavapai.

Next below the Ozaras Argüello listed the *Alebdoma* (Halchidoma). His statement that the "Pimas of the sands" were to one side of the Halchidom (and therefore north of the Gila, as he located the latter above the junction at that time); the more recent history of the association of the Areneños, the Sand Papago, with the junction area, culminating in the final settling of some of them at Dome; and the occurrence along the Gila (Schroeder 1952, map and Table 1) as well as south into Sonora, of Palomas Buff, a type of Lower Colorado Buff ware the relationship of which to the other types is least certain (Schroeder 1952: 31); all suggest the possibility that the Ozaras and the Sand Papago were the same people and were the occupants of northwestern Papaguería between the Sonoyta, Gila, and Colorado rivers, perhaps even ranging across the lower reaches of the Gila. This is not to suggest that Yuman-speaking people did not traverse the area — there is abundant historical evidence that they did — but that properly speaking they could not have been considered as inhabiting it.

I propose that the archaeological boundary postulated by Gifford be extended up the course of the Sonoyta River through the Ajo Valley toward a point a few miles east and slightly north of Ajo (Fig. 106). At this point it must be left floating, until information is available to extend it, although I venture the prediction that it will be found to swing back northwest toward Gila Bend. However, I suggest that it represents not an ethnic boundary, but a cultural one, for language and culture were not coterminous in this area.

Summary

A relocation is proposed for the linguistic boundary set up by Sauer between the Yuman-speaking people of the lower Colorado and Gila rivers, and the Piman-speaking people of Arizona and Sonora, and an extension and change of designation of the archaeological boundary located by Gifford between the mouth of the Sonoyta River and the Punta Peñasca-Cholla Bay region on the Sonora coast.

It is suggested that the linguistic boundary be drawn closer to the Gila and Colorado rivers, on the south and east sides respectively, to include only the valley proper of each river (Fig. 106). The initial point of the other boundary remains as established by Gifford, and the boundary is extended up the Sonoyta River to Quitobaquito on the present international boundary, thence northeastward through the Organ Pipe Cactus National Monument, where there is an area of overlap of 2 cultures, toward Gila Bend. It is suggested, however, that this represents a zone of cultural, rather than ethnic, difference; that is, that the people on both sides of this cultural boundary spoke Piman, perhaps with a dialect difference, the group on the western side of the boundary having had a basically Yuman culture, at least in the material aspects, and possibly in non-material traits as well, in contrast to the Piman culture which existed to the east.

It is further suggested that the principal occupants of the area between the cultural and linguistic boundaries were the group known historically as the Areneños or Sand Papagos, that this group was the one referred to by members of the Oñate expedition as Ozaras, and that one of the identifying traits of the group may be the pottery type presently designated Palomas Buff, a type of lower Colorado Buff Ware.

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ARIZONA STATE MUSEUM
Tucson, Ariz.
March, 1954

NOTICE

The mimeographed statement entitled "Archaeological Standards" which was distributed to the membership of the Society by the President through the Secretary has apparently been a source of some confusion and misunderstanding. The origin of the statement is a request by members of the Society to the President and Executive Committee in May, 1953, that an official statement be prepared setting forth the basis on which persons hiring archaeologists for professional work could best judge their qualifications. Therefore, the Executive Committee asked Frank H. H. Robert, Jr., and Waldo R. Wedel to undertake this task. They agreed to do so, and in May, 1954, submitted their statement to the Executive Committee which decided that before becoming the official policy of the Society any such statement should be voted upon by the membership. At the Annual Meeting the members present voted for neither acceptance nor rejection, but rather, voted to have the statement circulated to the membership for further consideration. At present the statement has not been finally acted on and does not represent the official stand of the Society. Roberts and Wedel deserve appreciation for their generous efforts to state clearly what qualifications are necessary for professional work in the field of archaeology, at various levels of supervision and responsibility.

FACTS AND COMMENTS

THE DENBIGH FLINT COMPLEX IS NOT YET DATED

Every radiocarbon sample that an archaeologist turns in to a physicist for dating has its particular story to tell. The story is likely to be much longer and more devious than is easily expressed in a simple number. I am a little worried about our use of "lists" of radiocarbon dates in view of the recent treatment of some dates from Cape Denbigh.

During the field seasons of 1948, 1949, and 1950 we secured from the Denbigh Flint layer no more than a small pillbox full of charcoal. When this was submitted to Libby, at the University of Chicago laboratory, he regretfully notified us that the sample was not enough to coat a cylinder. Our 4th field trip to Cape Denbigh, in 1952, was made for the express purpose of scraping together enough organic matter for analysis of the oldest cultural layer. At the end of the season I forwarded to Libby some of the samples collected, with the following notations:

> We were successful in finding two hearth areas, the charcoal in which was mainly in small flecks. By carefully scraping, we secured several pounds of charcoal mixed with earth, all of which is from the thin layer in which only Flint Complex artifacts are found. . . . I have not attempted to separate the charcoal from soil for fear that I would lose some of the datable material. I hope you have some way of handling samples of this kind in your laboratory. . . . Perhaps I should mention that both samples are taken from unfrozen ground. According to Hopkins' conclusions, the DFC was deposited when the climate was relatively mild. Later, during a cold period, permafrost prevailed, and the DFC layer was subjected to folding in solifluction lobes. After that there seems to have been no more permafrost to the present time. Grass roots deep in the ground indicate that the old layer has probably been penetrated by other organic materials since its deposition, and the unfrozen nature of the ground during most of the time with which we are concerned would have left it subject to the percolation of water from above. Perhaps these factors should be considered in preparing the charcoal for dating.

Libby very kindly explained to me in a letter giving results of this dating that sample number 2 had been washed with acid on its second run to test whether the first run of 4253±290 had been too young. The second run had given a date of 5063±340. Sample number 1 averaged 3509±230 years with no sign of similar contamination in the laboratory. Libby acknowledged my remarks about possible contamination of the original deposit by doubting that the inclusion of rootlets was serious.

All of this was routine handling of samples by Libby and his associates, and I felt no apprehension about having the dates appear in print. I regarded them as having been obviously contaminated after the ground, if only because of the 1500 or so years discrepancy between the two samples, which I am sure were collected from the same thin cultural level, though some horizontal feet apart. I was somewhat dismayed to find that the official release of these dates to the press and public contained no mention of my thoughts on possible contamination, but I still did not anticipate their complete acceptance as dating the Denbigh Flint complex.

Shortly after the publication of the dates, a news release from another institution carried a story in which it was pointed out that the Denbigh Flint complex was much younger than it had been thought by some. This was not unexpected in a popular account, but since that time such treatment of the dates in question has appeared in scientific journals, and, furthermore, in support of hypotheses of some significance. Alex D. Krieger, for example, editorialized as follows:

> Collins and others have argued that, while Denbigh may be as ancient as Giddings has proposed, it may be much more recent and only slightly older than Eskimo culture; it has close ties with Dorset in stone technology, and the list of radiocarbon dates released by the University of Chicago on September 1, 1953, gives average determinations of 4658±220 and 3509±230 years for two samples associated with the Denbigh Flint complex (the highest of these determinations is 5063±340 years). (Krieger 1954: 275)

Henry B. Collins does not seem to have questioned the published dates, either. He very recently has said (1954:84), "Ipiutak is not the only example of the late survival of ancient culture traditions among Arctic peoples. The Denbigh Flint complex, now dated by radiocarbon at around 3,000 to 2,000 B.C., and with a stone technique of Neolithic character, also possessed typical Aurignacian burins. At early Neolithic sites in Siberia the same types of stone implements, including burins, are found in association with pottery."

In the face of statements like these, I feel I must speak up. None is in better position than I am to evaluate the samples for which we have radiocarbon dates because I scraped the samples into cans and labeled them, and I saw that living grass roots penetrated the old layer even at its deepest. I do not think these samples can possibly date the Denbigh Flint complex. As a tree that grows out of a house ruin offers by its ring count a "stop-date" forward in time for the house, so I consider the 2 sets of radiocarbon dates to afford a stop-date forward for the Denbigh Flint complex, assuming that the samples were correctly analyzed. They form a time barrier, at some earlier time than which the Denbigh Flint complex was deposited. The older sample is the stop-date of significance if it has been subjected to no laboratory error.

This is not the time to discuss the cultural affiliations of the site, but I must make one further point. I did not associate myself with any specific dating for the Denbigh Flint complex until after the geological background of the Iyatayet site had been carefully studied by Hopkins. I was unwilling to attempt a dating on cultural materials alone, as anyone will recall who has read publications under my name. On the basis of geological and cultural evidence and available radiocarbon dates, however, Hopkins and I wrote a considered report (1953). In a recent talk with Hopkins, I found that he sees no more reason than I do to revise our paper in view of the radiocarbon dates thus far obtained.

In November, 1954, after this paper had been accepted for publication, Hopkins wrote the author as follows:

The new data . . . available since we wrote "Geological Background of the Iyatayet Archeological Site" indicates that our preferred dating of 8,500 years before present is of the right order of magnitude for the age of the Denbigh flint culture, and that our alternate suggestion that the Denbigh layer might be pre-Mankato and more than 10,000 years old can be ruled out completely. The geological, paleobotanical, and radiocarbon evidence available at present leads me to a firm conviction that the Denbigh flint culture at Iyatayet is more than 5,000 years old and less than 9,000 years old.

A program for extensive series of dating in Arctic archeology is now in progress, however, and it seems likely that much light will be thrown on the whole problem of Arctic dating within a year's time. In the meantime, I shall be working hard at presenting the finds at Cape Denbigh in as great detail and as objectively as possible in my final report on the 8 sites that we investigated during 4 field seasons.

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J. L. GIDDINGS, JR.
University of Pennsylvania
Philadelphia, Pa.
August, 1954

WAVE ACTION AT GEORGE LAKE 1, ONTARIO

In a recent issue of AMERICAN ANTIQUITY (Vol. 20, No. 2, pp. 101-11, 1954) Thomas Lee states that several geologists reject wave action as the cause of the worn condition of some of the blades found at the Sheguiandah site in Ontario, Canada. This fosters doubt in his mind that I am right in assigning wave action as the cause of the worn condition of artifacts from George Lake 1, 25 miles to the east. This is a matter of crucial importance for the site because it involves the only method of establishing the contemporaneity of cultural material with construction of the beach by waves at an elevation of 297 feet above the present level of Lake Huron.

The most secure support of wave action at George Lake is the abrasion of the artifacts to the same degree and in the same manner as the cobbles of the beach itself. Both are in the condition described by sedimentologists as subangular. It is also important that the *aretes* of the implements are in most cases much smoother than the surfaces of the flake scars. Other facts are consistent with this interpretation. In another part of the site some 1200 feet from the beach proper and at a lower level no abraded artifacts were found, and there is no definite beach, that is, strong wave action was absent. The specimens from the main beach are abraded on both surfaces and all edges are heavy and large. The abrasion was not intentional, nor was it due to use, as is indicated by 2 halves of the same blade found some distance apart, ½ of which is heavily abraded even over the broken edge, while the other is in a fresh condition. As to action by windblown sand, the geologists G. M. Stanley, Kirk Bryan, and E. C. Case saw some of the abraded blades several years ago, and none of them brought up the subject. I discussed the matter in correspondence with Ernst Antevs in 1949, and on his advice that facets and ridges are necessary to show sandblasting, I discarded wind action as a possibility. Furthermore, none of the implements of flint or quartzite from the sands of 2 other raised beaches in the Killarney area is abraded, and at both the positions are much more exposed to the wind than at George Lake 1. Cobblestones are completely absent from these sands. The conditions for abrasion by water action are present at the George Lake site. It is unquestionably a true beach, with half or more of its bulk made up of cobblestones averaging perhaps 3 inches in diameter. It was they that altered the surfaces of the artifacts, probably more by abrasion than by impact.

The foregoing indicates that beyond reasonable doubt the abraded artifacts at George Lake 1 were there when the waters of the Lake Huron basin were at that level, but the same for the unabraded artifacts is not necessarily indicated. All, or some, or none of them may have been there when the site was awash. There is no final answer. Twenty-one artifacts are abraded on all surfaces and edges, and this is about 5 percent of the total number of artifacts, excluding flakes, from the site. Of these only one is a recognizable type. This, the most completely abraded specimen of the lot, is in an unfinished condition. It is 7 inches long, 2¾ inches wide and ¾ of an inch thick. The outline is that of a projectile point with one complete shoulder and the other side a single slanting line. It was to have been either a stemmed point or a single-shouldered point 3 or 4 inches long. Two of the former, in a finished condition but with the tips missing, were found at George Lake 1, and 2 of the latter that closely resemble the Sandia 1 type, were found in the beach gravels at Chickanising Creek 1, 2½ miles south of George Lake 1 at an elevation of about 52 feet above the level of Lake Huron.

This is all that can be said with certainty about the abraded implements from George Lake. Some of the 21 are of the type I have been calling semilunar blades, but I am not now inclined to place very much confidence in that designation. They could as well be unfinished stemmed or single-shouldered points. The asymmetry favors the latter. But the geology of Chickanising Creek 1 as at present interpreted supports no such antiquity as that assigned to the Sandia Cave material, nor does the elevation above Lake Huron of George Lake 1.

The unabraded specimens from George Lake are chiefly unfinished ovate blades ranging in length from 4 to 13 inches. Most are broken in half, which is the

reason they were never finished. There are about 314 such fragments, and 33 blades that are complete and mostly or all unfinished. This is giving some latitude to the word "blade." Many of these specimens are over 1½ inch thick. A few have straight bases. The remaining types are the "semilunar" blades, 1 side-notched arrowhead, the tips of 2 small perforators, several retouched flakes, and 3 hammerstones. One large, round end-scraper, the basal portion of (apparently) a drill and a large ovate-pointed core came from the lower terrace, the occupation of which was necessarily later than that of the beach proper. About 100,000 flakes were also collected from the site. There was no cultural material other than quartzite with the exception of one of the hammerstones, which is sandstone.

E. F. GREENMAN
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Ann Arbor, Michigan
November, 1954

COMMENT ON QUIMBY'S "CULTURAL AND NATURAL AREAS BEFORE KROEBER"

One is forced to admire Quimby's enterprise (1954, *American Antiquity*, Vol. 19, No. 4, pp. 317-31) in attempting not only a characterization but a mapping of the paleogeography of North America at 7 stages between 8500 B.C. and 500 B.C. Among other things it shows a healthful awareness that the physical environment cannot be considered a constant even in the relatively short time span generally accepted for the New World archaeological record. Fruitful investigations can be pursued through coordinating the geological, climatological, paleoecological, and archaeological evidence over extensive regions, and this tentative essay may provide a needed impetus.

On the other hand, certain of the hypotheses presented in this paper seem to me to demand immediate examination before they become established dogma to burden subsequent investigations. I shall not question the eclectic use of 2 main chronological frameworks, those provided by Antevs and by radiocarbon dating, though the former, at least, is hardly established fact (Burma 1950).

The most grievous remark appears in the introductory paragraphs. The statement, "Climate, which possibly is more the result of, than the cause of, glaciation . . ," is no less ridiculous than, "Atom bombs, which possibly are more the result of, than the cause of, mushroom clouds. . . ." To what are glaciers to be attributed, a sudden upsurge in the output of the ice factories of the abominable snow men? Even the author could not maintain this position through the article. On page 327 he says: "The relatively rapid melting of the ice was caused by the warm climate that prevailed at this time (within the Altithermal period)." Paleoclimatology, based on modern understanding of the dynamics of atmospheric circulation, is not the most firmly established of disciplines, but real progress has been made in recent decades (Simpson 1934; Willett 1949; Leighly, 1949; 1953). In his extensive bibliography Quimby shows a respect-commanding familiarity with the literature on late Pleistocene geology and ecology, but cites only a single climatological reference.

It seems likely that a second dubious conclusion results from the same de-emphasis of the climatic factor: that the continental glacier of eastern North America receded into Hudson Bay until it became an iceberg floating in that body of water. This interpretation may be correct, but it is certainly at variance with Flint's conclusion that the Quebec-Labrador highlands maintained their ice the longest (Flint 1947: 243-5), and seems to be original with Quimby. So far-reaching an hypothesis needs more supporting evidence than (p. 320): "In fact as subsequent maps will show, the only sensible way I can get rid of the ice sheet is to have it shrink into the middle of Hudson's Bay." Bird's (1953) demonstration that there was ice east of Keewatin as that area was deglaciated, certainly does not deny the presence of ice east of Hudson Bay. It may be pertinent to observe that the better-known Fenno-Scandian glacier did not recede into the comparably located Gulf of Bothnia (Flint 1947: 316, 412).

The paper includes a series of maps of North America which, quite properly, shows the extent of glaciation at each stage in dashed lines. The extent of the prehistoric lakes is similarly properly qualified in the text, as is the land bridge across Bering Strait which appears in the first 4 maps. The other coast lines and the Mississippi and its tributaries are clearly and rather carefully drawn in solid lines, but they follow strange courses which are not explained or justified in the text. The mutations of the coastlines in the Arctic Archipelago may have resulted from a combination of eustatic change and isostatic upwarp following the melting of the continental glacier, but no evidence for these complex changes, which occurred in a scarcely mapped region, is cited. If the closure of the Bering Strait resulted from a eustatic change, why are the shorelines of the United States absolutely the same as at present? At least a doubling of the extent of the Florida peninsula would seem to be called for. On each of the prehistoric maps the Ohio River enters the Mississippi near Vicksburg, and the latter enters the Gulf of Mexico by the Atchafalaya bypass. On the other hand, the birdsfoot delta of the Mississippi seems to maintain a perfectly modern outline. The paper makes no reference at all to these significant events. This is a region where the courses of rivers and the relation of sea and land are unstable even in time periods shorter than those treated in the paper. A tremendous misconception is encouraged by showing some changes and completely omitting others.

Finally, I must admit a recurring irritation when I cannot find listed in the bibliography all the papers cited in the text. In this paper I counted 17 such citations, apparently referring to 9 unlisted papers.

I hope that it will be recognized that most of these critical comments are directed toward the peripheral aspects of this paper. Had the paper dealt only with the

northeastern part of the continent, the area for which Quimby has examined the data thoroughly, there would have been little need for criticism. A paleogeography of the whole of North America is still needed, but it cannot be projected from an examination of a small fraction of the area.

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HOMER ASCHMANN
University of California
Riverside, Calif.
October, 1954

REPLY TO ASCHMANN'S COMMENT

I read Aschmann's comments with great interest, welcome the opportunity to reply to them, and wish also to add some comments I have received by letter from others.

I used the terminology of Antevs, but not his chronological framework, which is quite different from that presented tentatively by me. In fact, I feel certain that Antevs would be much rougher in his assessment than Aschmann.

My grievous remark on climate stems from ignorance and my impression that the cool periods followed the glacial advances. Among the implications of such an idea are that somehow additional precipitation in high latitudes caused the glacier to grow and this in turn somehow produces in varying degrees a cool climate locally, probably somewhat dependent upon the magnitude of the icecap. I suppose that such factors as prevailing wind direction, tracks of high and low pressure areas and positions of large bodies of water are among the variables that would have to be considered. But in general I don't know the reason for hot or cool periods.

The available dated phenomena that clearly demonstrate the presence of a large icecap seem to lie along the periphery of the Hudson Bay basin. Moreover, this basin has undergone tremendous uplift some of which is obviously very recent. These factors are among those that led me to believe that the Laurentide ice was confined to this basin in the late periods. I would not deny the presence of smaller bodies of ice elsewhere. I don't see why the Fenno-Scandian analogy is relevant. Compared to Laurentide it was an ice cube. Moreover, when in heat, it could retreat to the mountains.

The courses of the Mississippi and Ohio rivers have been taken from Fisk (1944) with some modifications. Their late chronological position is based upon the radiocarbon date of about 400 B.C. for a site in Mississippi situated on what, at the time of occupation, was a natural levee of the Ohio River.

The mutations of the coastlines of the Arctic Archipelago are based on Flint and others (1945), but their chronological position is a function of my belief that the Laurentide icecap was a big mass rather than detached chunks and that it centered in the Hudson Bay basin during the periods of deglaciation.

I should have indicated seaward extensions of the Atlantic coast line and especially western Florida and the Gulf Coast, even though the amount of extension is unknown. In this connection it is useful to note that Fisk (1944: 38, 68) indicates that the sea level was at least 400 feet (perhaps 450 feet) lower than at present during the late Wisconsin.

I regret the omission of some references in the bibliography and will add those that I can find to this note.

Interesting letters received from David M. Hopkins, Acting Chief of Alaska Terrain and Permafrost Section of the U.S. Geological Survey, and Troy L. Péwé, Engineering Geologist of the U.S. Geological Survey, show that the recent geological history of Alaska is far more complex and different from what I indicated. Hopkins writes, "There is now strong evidence throughout Alaska . . . for a warm period about 8,000 to 9,000 years ago, an important glacial advance . . . about 4,000 years ago, another significant warm interval 3,600 years ago, a glacial advance between 3,600 and 2,000 years ago, and the well known glaciation of a few centuries ago." Among other items of interest Péwé writes, ". . . as far as I have been able to find out, there has been no significant, if any, change in the vegetation at Fairbanks for the last 30,000 years; yet there have been slight changes in climate as evidenced by the study of permafrost, geochemistry of silt, and the erosional record."

Two extremely interesting ideas have been presented in a letter from John T. Curtis, professor of Botany at the University of Wisconsin. Curtis says the Two Creeks "forest was killed by a rise in the level of Lake Michigan . . . prior to the occupation of Two Creeks by the Valders Ice itself. The bed was covered by a lacustrine deposit before it was covered by ice. . . . Thus the Valders climax . . . was . . . more recent than 9,453 B.C."

Curtis also writes, ". . . our studies of the northern conifer-hardwood forests clearly indicate that pines are

fire-trees and cannot be a major permanent component of the vegetation in the absence of fires. Therefore, we are inclined to interpret the presence of pine dominance in pollen profiles as an indication of the presence of hunting Indian cultures, rather than primarily as an indication of a warm, dry climate." If the interpretation of Curtis is correct, I have been barking up the wrong trees.

It probably will be some time before there is a generally accepted reconstruction of cultural and natural areas in late glacial times. A variety of opinions already have been published. Unlike Aschmann, I doubt that the certain hypotheses presented in the original paper will "become established dogma to burden subsequent investigations." The mortality rates on my previous dogma are too high.

Below are corrections and additions for the references in the original paper:

For Fairchild (1908) read (1909); for Ritchie (1952) read (1951); for Sears (1942) read (1932); and for Stanley (1943) read Greenman and Stanley (1943).

Items marked thus (*) should have been listed in the original paper. Unmarked items are those I have read since its completion and would like to have included. In addition I would like to recommend a forthcoming paper by James Zumberge and John E. Potzger, to be published probably by the Geological Society of America.

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GEORGE I. QUIMBY
Chicago Natural History Museum
Chicago, Illinois
November, 1954

A CORRECTION ON "PRECLASSIC METAL?"

The evidence for locating the find of sheet copper, reported by R. E. Smith (1944) and commented on by John L. Sorenson in AMERICAN ANTIQUITY (1954), has proved thoroughly unreliable.

Since the publication of the above find, which included 11 pottery vessels and other artifacts, I have learned that the pottery most probably did not come from San Miguel Ixtahuacan at all. Nothing even vaguely similar has been unearthed from that vicinity. It is much more closely related to material from the Salcaja-Momostenango region, as I pointed out in the article. Therefore, if the informant and original owner of the collection gave inaccurate information as to the provenience of the collection, he may also have been in error as to copper being found in one of the above pre-Classic vessels.

This material was published in order to preserve the lot as a whole for students, because without regard to its provenience the pottery appeared to be a homogeneous collection, presumably found in a single grave or various graves of the same ceramic period.

This seems to me an excellent example of why it is best not to publish doubtful material unless explicitly so labeled because all finds are doubtful unless one can vouch for them without a question. In this case, I did not know the original owner and therefore my information was second hand. Furthermore, at the time of writing the article, I knew nothing about the pottery from the San Miguel Ixtahuacan region.

SMITH, ROBERT E.
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BURINS FROM CENTRAL ALASKA *

True burins that are directly comparable with a number of Old World types have recently appeared as prominent elements of a number of collections from the American arctic. Their areal distribution from Alaska (Giddings 1951) to Greenland (Knuth 1952; Meldgaard 1952) and possibly Labrador (Harp 1951: 215; 1953: 41), in a variety of coastal and inland sites, shows that the trait was not a novelty nor a figment of chance, but an integral part of several North American flint complexes. In certain instances, and particularly at the Alaskan sites, they are accompanied by other implements typologically similar to Old World Paleolithic and Mesolithic forms (Giddings 1951); elsewhere, they are found in complexes that may be more distinctively American (Knuth 1952; Meldgaard 1952; Harp 1951). Oddly enough, basal grinding, parallel flaking, fluted points, and other early American traits such as Oblique and Eden Yuma points, are more conspicuous in the "Mesolithic" Denbigh Flint complex than they are in stages found farther east, for which there is less evidence for close connections with the Old World. However, Harp reports a fluted point in a Newfoundland assemblage (1951: 209).

It is pertinent, in view of the trait's evident relationships with early Arctic cultures, to draw attention to some burins that were recently identified in a collection of "pre-Athabaskan" age that was taken in the 1930's from the University of Alaska Campus site, near Fairbanks.

A re-examination of the Campus site material was prompted by the announcement of Richard S. MacNeish at the 1952 meetings of the Society for American Archaeology in Philadelphia that he had discovered, near Fort Liard, Northwest Territories, burins, prismatic flakes, and prepared polyhedral cores. The assemblage looked quite different from the Denbigh Flint complex, where these forms occur. However, inspection of a few of MacNeish's specimens and later the photographs which appear in his paper (1954) showed a detailed, and I think, significant, resemblance between some of his Pointed Mountain material and types characteristic of the Campus site. In particular, MacNeish's "tongue-shaped cores" (p. 239), as distinguished from his subconoidal variety, are strikingly similar to cores from the Campus site where subconoidal cores do not occur. MacNeish has listed a number of other parallels, of varying significance. A search was made of the Campus site collection for additional similarities, with the result that 2 burins and a burin spall were identified. Another type found, which can be described as a flake gouge, may also have parallels in the Pointed Mountain complex, in the form of MacNeish's "lamellar flakes with retouched rounded ends" (p. 242). These implements will be described here so that they can be included in the typology of the Campus site. No attempt has been made to compare the whole assemblage with the Pointed Mountain complex.

The Campus site was excavated during the period 1934-36 by Charles E. Bunnell, then president of the University, John Dorsh, Froelich G. Rainey, and several undergraduate assistants. Reports on the excavations and the material recovered have been presented by N. C. Nelson (1935, 1937) and Rainey (1939). A small type collection is at the American Museum of Natural History; the rest of the material is now in the Museum of the University of Alaska. The Campus site is on the brow of a hill which drops off steeply to the broad level floor of the unglaciated valley through which the Tanana River follows a course at present some 4 miles to the east. Cultural remains were found throughout most of the area of 100 m. radius in which test pits were dug. These are regarded by both Rainey and Nelson as comprising a single artifact complex devoid of recognizable intrusives.

No hypotheses have been advanced as to the actual age of the material. However, Rainey (1939: 388; 1953: 43-4) regards it as typologically distinct from the Athabaskan collections because it lacks copper and artifacts made of organic substances. Moreover, it contains semilunar scrapers chipped on one face, cleavers, and small elliptical biface blades, none of which occur in the oldest known Athabaskan site in Alaska, Dixthada. There are also 34 prepared polyhedral (microblade) cores out of a total of 353 implements. This further distinguishes it from the mixed Dixthada collection, in which only 2 of the 496 implements are prepared cores. Nelson (1937)

* Publication of this note, prepared in the fall of 1953, has been delayed by my absence during an extended period of field work. Several revisions and additions, made after the appearance of MacNeish's recent paper (1954) are apparent in the text. Discussion with MacNeish in 1953 resulted in our agreement on most, though perhaps not all, of the points of typology common to the Campus site and Pointed Mountain that are mentioned here. Ivar Skarland and James W. Van Stone, of the University of Alaska, and Hallam L. Movius, Jr., and Gordon R. Willey, of Harvard, have kindly read the manuscript and made pertinent suggestions.

commented on the remarkable similarity between the Campus site cores and some from a pre-Neolithic site he had found in Mongolia. (The Mongolian material, now in the American Museum of Natural History, has not yet been published in full.) Rainey (1940) found the whole range of Campus site implements virtually duplicated in material from several epi-Paleolithic sites in the Lake Baikal region.

MacNeish has used several kinds of geological and pedological evidence to infer an age of 5000 to 8000 years for the Pointed Mountain site (p. 237), which he considers closely related to the Campus site (p. 250-1). The general similarity of the 2 complexes is obvious; however, I do not think that comparative analysis has yet been carried to the point where the Campus site can be dated on the basis of its relationship to Pointed Mountain. These typological considerations mean that the age of the Campus site is a matter of several thousand years, but this is the limit of precision at this point. Similarly, there seems to be a close, even an exclusive, relationship between material of this sort from boreal America and parts of the prehistoric sequence in central Asia, but the nature of it is still beyond our grasp.

The amorphous state of classifications for arctic stonework requires that laborious attention be given to typology. One of the burins (M2028) (Fig. 107, *1*) was made on what appears to be the center section of a bifacially chipped 2-edged blade which was probably broken by accident. One large flake has been removed from the top along one face, but the scar does not intersect the working edge. Another blow was struck at one end of the working edge, but the fracture was interrupted by a grain of quartz in the chert. The tool was not otherwise shaped before the removal of 2 spalls by longitudinal burin strokes, each of which left a negative bulb of percussion clearly visible at the top. The dimensions are: cutting edge to base, 2.7 cm.; maximum width, 1.8 cm.; maximum thickness, 0.7 cm.; and thickness just back of the working edge, 0.5 cm. The working edge is a convex, protruding lip rather than the classic "screwdriver," but this feature has no typological significance.

The second burin (M2094) (Fig. 107, *2*), which is identified with some reservation, is made of gray chert patinated to a lighter shade of buff throughout most of its length before it was taken from the original core. It may have served once as a small straight-based point, from which the distal end was broken. However, it does not conform closely to other forms of points found in the collection. The edges that remain are sharpened by secondary chipping, which makes it lenticular in cross section. The maximum dimensions are now 2.8 by 1.4 by 0.5 cm. A single longitudinal scar extends from one corner of the base ⅓ of the way along the edge. Since the spall did not terminate in a hinge fracture, it took with it any traces of additional scars. It should be emphasized that this piece would not be acceptable as a burin if it were found by itself, and its identity, even in company with the other, remains questionable.

These 2 implements can be classified as "converted burins" — burins made by a blow on a broken edge (Noone 1934: 84). They differ from the majority of the burins found in the Denbigh Flint complex, which generally have edges that were "scaled" or "spalled" before the final burin stroke was made (Giddings 1951; Irving 1953). The Campus site burins resemble those from Pointed Mountain in that they lack a distinctive specialized form, being made on flakes or fragments the shape of which is fortuitous. In this respect, both groups differ from the Denbigh types.

None of the burins from Pointed Mountain are described as having been made on a broken bifacial tool; however, the number of implements is very small in both cases, so this point of difference may be of little significance. MacNeish (p. 246) makes an error in attributing "angle burins" to the Campus site. The 2 burins that have been recognized belong in his "corner burin" category, the distinguishing characteristic for which is an angle of about 90° between the burin facet and the opposing edge.

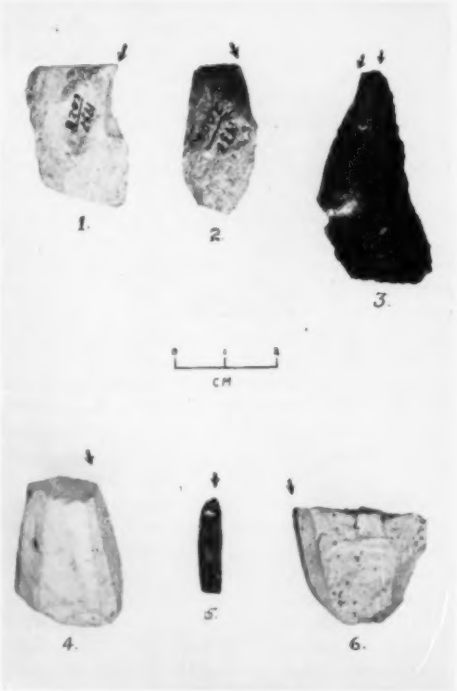

FIG. 107. Implements from the University of Alaska Campus site. *1*, burin (M2028); *2*, burin ? (M2094); *3*, "lamellar gouge"; *4* and *6*, polyhedral cores; *5*, burin spall.

Of more certain identification than the second Campus site burin, but still somewhat doubtful, is a burin spall (Fig. 107, 5) of black chert 1.8 cm. long by 0.1 cm. thick by 0.4 cm. wide. It apparently comes from a gouge-type angle burin (Burkitt 1948: 61), which would fit in Noone's "scaled" order. It is retouched by fine chipping from one side along the edge opposed to the burin facet, to produce a blunt working tip. A prominent percussion bulb is visible on one face; the negative bulb presumed for the opposite face was removed by an abortive burin stroke that left a barely distinguishable bulb of its own. The spall terminates in a hinge fracture. Some of the burins from the Pointed Mountain site have also been retouched along the edge which intersects the burin facet.

The 3 artifacts conform in general to the specifications for burins and spalls presented by Burkitt (1948). Only the second burin could have been made fortuitously, and, although ordinary caution suggests that the spall be regarded as doubtful, its resemblance to a large series of burin spalls from Denbigh Flint complex sites makes it valid supplementary evidence for the burin technic. Numerically these are a minor, almost an insignificant, portion of the collection, but, since there is no reason to believe them intrusive, burins must now be considered as one of the distinguishing traits of the Campus site.

The "flake gouge" (no number) (Fig. 107, 3) warrants treatment because of the unusual technic of its manufacture, the rarity, in this collection, of flaking material of such good quality, and its resemblance to some types described for Pointed Mountain. It has previously been illustrated and described by Rainey as one of a group of retouched flakes "which are obviously complete tools" (1939; 384, Fig. 7). The tool is made on the end of a flake of homogeneous black chert, one edge of which is unifacially retouched to serve as a concave side scraper. This function may well have been subsidiary to that of a gouge, for which the flake was apparently intended. The gouge end of the flake has a fairly straight, transverse, beveled edge formed by the removal of long, narrow spalls by pressure along one side and the upper surface. The fine retouch on the plane bulbar surface was probably caused by use. All of the visible scars represent spalls removed by blows or pressure in the direction of the blow that detached the flake from the core, that is, from the working edge backward. The tool could have been used with the cutting edge in either the horizontal or the vertical plane. In the latter case, its function would have been that of a burin. Indeed, a case could be made for calling it a burin, but this would make for disorderly typology at this stage. This tool in particular, and probably the somewhat variable class of which it is a member, resembles MacNeish's end-retouched flakes and prismatic flakes more than do the retouched prismatic flakes of the Campus site, all of which are probably retouched only by use.

In this hemisphere, burins occur commonly in a context characterized by prepared polyhedral cores, their derivative prismatic flakes, and implements made with consummate skill by means of the pressure-flaking technique. Most remarkable among these industries is the one represented by the Denbigh Flint complex (Giddings 1951). However, burins occur in other situations as well, and evidently persisted in one form or another through a long period of time (Meldgaard 1951; Collins 1953). Collins (pp. 200-1) points out that the mere presence of burins is not sufficient reason for deciding that a collection is very old, since they are found in Dorset material for which no claim of great antiquity is made. It is true that the only published reports of burins from the western artcic present them as being closely associated with the Denbigh Flint complex, which may be 6000, 8500, or 12,000 years old (Collins 1953; Hopkins and Giddings 1953). [EDITOR'S NOTE: Elsewhere in this issue Giddings and Hopkins indicate that the 8500-year age is the most probable.] This, however, does not give even a *terminus post quem*, for burins may well have been made in Alaska long before the Denbigh Flint complex appeared.

The real importance of the Campus site burins does not result from their very questionable value as age criteria, but rather from consideration of their place of origin, in the wooded interior of Alaska, and of the types that accompany them. An examination of both these factors indicates a relationship, not yet clearly defined, with the horizon at Fort Liard containing tongue-shaped cores, prismatic flakes, and simple burins with little or no retouch, accompanied by stemmed points and large and small ovoid biface blades, to mention a few of the common types. On the other hand, the Campus site material resembles that from Cape Denbigh and other finds in the tundra zone in only a few very generalized features, and lacks the most characteristic Denbigh traits: fine, parallel flaking, small bifacially retouched side blades, and burins of specialized form. The boreal forest sites discussed here seem to hang together, and lack the types associated with early man which appear in the Denbigh Flint complex. They seem to belong to a line of development different from that found thus far in the Eskimo area.

There is no indication at present as to where or when the differentiation of the 2 apparently distinct burin- and prismatic flake-producing industries occurred. Their dissimilarity, both as wholes and in particular types, and their apparently divergent affiliations suggest that it may have taken place on the other side of Bering Strait. In any case, the peculiar distribution of burins must be considered for its bearing on the enigma of cultural similarities between boreal North America and Asia, as it is presented by Spaulding (1946: 167). On the basis of publications to date, the Campus site is in the curious position of appearing to be more closely related to early facies in Central Asia than is the Denbigh Flint complex, although the latter is geographically nearer.

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TWO CIST BURIALS FROM SAN JUAN ISLAND, WASHINGTON

The current status of archaeological investigation in the northern Puget Sound region is one of demarcation and elucidation of problems. Lately, the approach has been toward the accumulation of descriptive information on sites and artifacts. The San Juan Island group, at the southern extremity of Georgia Strait, is increasingly important in this process. The extensive cist or cairn burial development at Armadale Valley is merely one of a number of adjacent sites in the intricate complex of headlands and inlets formed by Westcott, Garrison, and Mitchell bays of the northwestern portion of the San Juan Island.

The major group of cairns lies atop a low rocky bluff, overlooking Westcott Bay to the east and the narrow but protected thoroughfare of Mosquito Pass to the west. Immediately below the site, at the base of the bluff is a deep and extensive shell midden. Atop the bluff and extending a short distance to the northwest, the burial area is obscured by dense undergrowth and numerous large trees. Annual rings of several stumps disrupting cairns yield ages of 70 to 90 years.

Cairn 1, in an area of thin soil and rocky outcrops, appeared before excavation as a group of disoriented, angular boulders. Constituent members emerged from a low mound 12 inches higher than the surrounding surface. Gross dimensions approximated 96 inches north to south and 92 inches east to west. Excavation showed very scanty soil covering extremely uneven bedrock, and a pronounced but shallow groove in the bedrock running under the cairn at an oblique angle to the east-west axis. The north and west walls of the cist were formed by large rocks (50 to 250 pounds) resting in part on the bedrock on either side of the shallow groove. The east wall was formed by 2 large slabs with smooth sides inward, while 6 smaller slabs formed the south end. The result was a rectangular stone box, very regular in its internal dimensions, 48 inches north to south and 36 inches east to west. Two large stones, flat sides down, formed an incomplete cap to the structure. Only the large stones of the east and west walls rested on bedrock; the smaller stones at the south and the large slab of the northern wall rested on subsoil, 3 to 6 inches above the bedrock.

A tightly flexed burial lay in the bedrock groove 25 inches below the surface of the cist. Despite pressure distortion the skull showed a moderate frontal flattening. The pelvic girdle and the small bones of the extremities were absent; sex was uncertain; orientation was toward the south.

Cairn 2, 10 feet north of Cairn 1, appeared as a low earth mound with many small protruding stones. A single large tabular stone formed the south end. The long axis, north to south, was 168 inches. The structure was totally of stone, soil fill only serving as a binder between and overlying the stones. There was no order evident in the form or placement of these stones.

A fragmentary adolescent lay 31 inches below the cairn surface. A cranium, cervical vertebrae, a disintegrated scapula, and fragments of long bones were found. Degree of flexure was loose; the body lay on its left side, facing west with head north. The frontal area was probably flattened. The skeleton lay in a shallow depression scooped into the suface of the compact yellow subsoil underlying the cairn. On the thorax lay 2 large tabular stones, one of which crushed the mandible, leaving the skull intact, however.

The burial of Cairn 2 was intrusive into the yellow subsoil below the structure, with no evidence of intrusion from the surface. The stones covering the body were in turn blanketed and partially mortared by a fine brown matrix, which also forms the soil surface in the immediate area of the cairns. Cairn 1 was excavated into this surface, its wall stones resting partly on bedrock and partly on this soil. Therefore the construction of Cairn 1 was subsequent to the formation of the thin soil covering the bluff, and hence is later than the construction of Cairn 2, which lay under this soil.

There is currently no certainty as to the sequential position of such cairn burials in northwestern North America. With one possible exception (Smith, Harlan and J. Fowke, 1901, Cairns of British Columbia and Washington, *Mem. Am. Mus. Nat. Hist.*, Vol. 4, Pt. 2, p. 65) they have contained no artifacts and the conditions of discovery, masked by large trees and dense brush, argue for a respectable antiquity. Ethnographic descriptions of such burials are lacking; however, comparisons with the Plateau suggest that a considerable time span is involved.

Smith and Fowke describe the cairns of British Columbia and Western Washington as follows:

> The cairns are from three to twenty feet in diameter and generally consist of irregular piles of boulders. In some cases a more or less rectangular cist is built around the body, made by placing together a number of boulders, the straightest sides of which are placed so as to form an oblong cist. . . . In other cases there are slablike stones over the grave, but the cist is ill defined, if present at all. . . . Above the cist a rough pile of stones is reared. . . . The cairns were evidently all built on a well defined plan, looking towards the construction of a central cist, which, however, was often very poorly made (pp. 56, 63).

The conclusions reached in this paper do not invalidate this, but our sample is insignificant. However, the data presented here suggest that cist burial had a long duration in the area, and that a single basic structural form is not a necessary assumption, but rather that an evolution of cairn type toward a more regularized cist may have occurred.

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May, 1954

A FERTILITY VASE FROM THE OLD LINE, COSTA RICA

The rectangular clay bowl with a ring base shown in Figure 108 was unearthed in the area of the Old Line (Linea Vieja) in Costa Rica. It is 8.5 cm. high, 13.0 cm. wide, with an overall length of 18.5 cm., and is made of a well-fired clay painted in red. We consider this find most important as it appears to confirm the influence of foreign cultures in the area of the Old Line on the Atlantic side of the Republic of Costa Rica.

The receptacle of this bowl has lateral ornamentation consisting of 2 distinct groups. The first group, at the lower part of Figure 108 *a*, depicts the legs of a man with calves and feet in an upright position. This peculiar detail was probably used in order to secure the esthetic arrangement of the border decoration. We see the male genitals and on the thigh of each leg the figure of a bird. The one at the left appears to be pecking at a testicle, suggesting extraction of the male semen, while the bird at the right seems to be waiting for his turn in order to repeat this process with the other testicle. The second group, forming the upper part of Figure 108 *a*, shows the legs of a woman, spreading around the border of the receptacle. On each leg a bird is placed, suggesting the route towards the crural region in the center of which we find another bird, submerging its beak in the vulva of the woman, probably in an attempt to deposit the extracted semen for procreation (Fig. 108 *b*, *c*).

We believe this representation to be connected with the mythical origin of woman. In Peter Martyr's report on the mythology of the Greater Antilles we find the following: "These men they called *caracaracoli*. They went hunting and of the many they caught, they retained only four. They intended to make use of them as women, but found out that they had no female nature. Convoking again the ancient ones, they consulted with them what to do. They decided to search for the beak-bird [ave de pico], so that the same might produce an aperture with his strong beak between the groins, holding these same callous men *caracaracoli* the women *apertis cruribus*. Thus they brought the beak-bird and he opened the sex of the women in this graceful manner so that the island had all the women it desired. Thus descendance was procreated. . . ." (Mártir de Angleria 1944, Dec. 1, Lib. 9, Cap. 5.)

The vessel itself appears to date from just before the conquest. This arouses even greater interest, considering that this insular legend should have survived such a long time in the Old Line region. Joyce (1916:180) identifies the beak-bird as being a woodpecker. Yet we believe that in the original story it was meant to be the toucan, which eventually evolved into the legendary beak-bird of the Arawaks or Carib-Arawaks. The birds of Figure 108 strongly resemble parrots, but there is a possibility that the concept of the beak-bird might have degenerated over a long period of time, or that the

artist employed a current style, perhaps to be better comprehended by his contemporaries. Although one cannot take Peter Martyr's narration verbatim, the mythological manifestations that adorn the clay vessel suggest that procreation was believed possible through the assistance of the beak-bird. There are legends of this kind in other countries, and in Costa Rica some of the southern tribes still believe that the first man was brought to the earth in the beak of an owl. Examining the vessel it is obvious that it is meant to portray the transportation of the male semen by the beaks of birds to the genital region of the female, thus depicting an act of procreation. We believe that this vessel illustrates the procreation legend of the Greater Antilles, transplanted to Costa Rica.

There is further evidence of insular influence in objects from the Old Line. In some of the smaller stone figures carved of andesite such connections are recognizable. Female statuettes supporting their breast with both hands are found in the Old Line and also in the Greater Antilles (Joyce 1916, Pl. 21, *II*). The type of squatting figures and especially those with pronounced carving of the dorsal spine, a frequent trait in the Old Line, have their parallels in clay from Santo Domingo (Diaz Niese 1945, Fig. 5). Tobacco was used in the Antilles, both rolled into cigars and as snuff. The latter was inhaled through a hollow Y-shaped cane, the upper branches being inserted in the nostrils. There is evidence that this method was known in the Old Line sites, as snuff pipes of clay have been unearthed there, whereas so far we have no evidence of cigar smoking in this region.

In Costa Rica intricate carving sometimes ornamented ceremonial stone metates or altars (Balser 1953: 16). Here we reproduce 3-legged ceremonial metates (Fig. 109) of the latticed flying-panel type. Birds resembling toucans adorn the legs, while the center figure of the latticed panel (*a* and *b*) is a standing bird with protruding beak, and an angular continuation of the beak below an asymmetrical knob. We believe that these birds represent the beak-bird of the Carib-Arawaks. These metates or altars very likely were connected with procreation ceremonies, probably expressive of fertility or of abundance in general. The birds used to adorn their legs, and which we believe to be toucans, sometimes show the angular termination of the beak connected with the abdominal region (Fig. 109 *c*), thus demonstrating a joining of beak and navel. It is likely that these ornamental birds are a more realistic representation of the beak-bird.

Oviedo (1950, Cap. 42) refers to the toucan as an extraordinary bird which with its beak pecks holes into trees. Therefore, we believe that the legendary beak-bird is derived from the toucan. This is all the more plausible as it is a more attractive bird than the woodpecker.

Apart from Amazon art, this angular motif is not very frequently seen on indigenous artifacts, yet a similar motif appears in the art of Marajó, in the mouth of the Amazon. Kroeber (1949: 485) writes that at the time of the conquest the Indians of Marajó considered themselves to be Arawaks. It is interesting that we can trace the angular motive as a geometric decoration from an Arawak region, and that it occurs on an object which could be associated with procreation, the *tanga* or pottery pubic cover worn by women. It seems, therefore, that there is evidence of the existence of Arawak symbols applied as ornamental motifs on indigenous artifacts of the Old Line. This is additional proof of the manifold cultural influences from this region on the Atlantic side of Costa Rica.

Fig. 108. Fertility vase, from Old Line, Costa Rica (private collection).

FIG. 109. Tripod metates, from Old Line, Costa Rica, with carved flying panels. Length of grinding surface of *a* 40 cm., *b* 52 cm., *c* 50 cm. (*a*, private collection; *b* and *c*, Maximo Acosta collection).

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A BURIAL CAVE ON KANAGA ISLAND, ALEUTIAN ISLANDS *

The Aleut burial cave described in this report was found by the authors during field work in July, 1952. As the site was left entirely undisturbed, the information may be useful to parties programming future work in the Aleutian Islands area. Further, it may be possible on the strength of this description alone to relate the burial occurrence to known cultural traits. At the very least it will point out the existence of an intensely interesting isolated feature.

The cave is located at the base of a steep sea cliff on Kanaga Island at latitude 51° 43′ 44″ N. and longitude 177° 31′ 10″ W. (All locations are from the Army Map Service map of Kanaga Island, Sheet no. 3 of 5, scale 1:25,000.) A small kitchen midden was noted a short distance south of the cave. Two other places of interest in the vicinity are a large village midden across the island to the south (at 51° 42′ 25″ N., 177° 31′ 15″ W.) and another midden to the east (at 51° 45′ 05″ N., 177° 27′ 55″ W.) There is a convenient location for a base camp about 0.45 mile west of the cave; and, in 1952, there was a small, reasonably weather-tight trappers' shack 2.5 miles east, on the north coast. The shack is fairly convenient to the latter midden, but not to the cave. All localities are shown in Figure 110. About 2 hours were spent investigating the site.

The cave is roughly triangular in vertical cross section and is cut into steep sea cliffs of brown volcanic tuff-breccia. The floor of the cave is highest at about its center, where it is 9 feet above the upper limit of present barnacle growth (this level is here termed the "barnacle line"), and it descends toward the rear of the cave where it is 7½ feet above the barnacle line. About 30 feet above the barnacle line the upward-curving ceiling of the cave steepens to join the sea cliffs above. At the top of the cliffs, about 80 feet above the barnacle line, rolling tundra slopes from the inland surface of the island. The cave is the result of storm-wave erosion on the coarsely stratified volcanic rocks. In plan, the cave is irregular in shape, narrowing from approximately 50 feet in width at the mouth to 15 feet at the rear. The floor is generally smooth and continuous with the present gravel beach above which it rises. There is a low rock ridge across the sloping cave floor on the south side (dashed line, profile BB′, Fig. 111). Essentially, the lower surface of the cave is an inclined wave-planed platform overlapped at its seaward end by modern storm-washed gravels.

The cave apparently was not occupied as a living area. The profile sketch (Fig. 111) illustrates that it lacks adequate headroom, as the 7-foot height of the opening decreases continuously toward the back wall. There is no sooting of the ceiling or sides, nor is there at the surface any midden material — bone refuse, fish cartilage, sea-urchin plates, stone chips, or articles of daily use other than the crude bone point and carved wooden animal figure noted later. All the debris within the cave, including a group of beach boulders arranged in a rough circle, wooden boat parts, and human skeletal material, lies apparently undisturbed on the south half of the floor area. Six of 7 human crania present are in pairs, a male and a female crania to each pair. The site is too well ordered and too lean in occupational material to have been used even as a temporary dwelling place. The small midden to the south consists of a very small shelter cave and a few cubic yards of bone, shell, and sea-urchin plate refuse material associated with it. This shelter cave is considerably smaller than the burial cave so that although the refuse suggests appreciable occupancy the cave would appear to have been entirely inadequate as a permanent abode.

The artifacts of the burial site consists of 2 small carved pieces and many full-size boat-frame members. A 4¼-inch replica of a sea-lion (?) with a ball in its jaws is beautifully carved of soft wood (Fig. 112 *n*), unpainted, and with the underside rectangularly notched to provide the animal with stubby front and back legs. The plane surfaces of the notch suggest that the carving was intended to be fitted on another piece of wood or bone passing transversely under it. The other small carved piece is a barbless projectile or lance point of dense bone (Fig. 112 *p*). It is 3¾ inches long and ⅝ inch wide near the midpoint, flatly elliptical in cross section, with a tang ¾ inch high. The surface is quite rough and unpolished. The figure and the point were the only items collected.

Four sections of carved wood keel aggregating about 24 feet suggest a vessel of at least this length. These framing members are triangular in cross section, each about 6 feet long (Fig. 112 *h*). One or both ends of each piece are rotted, so it is possible they once were longer; 2 are notched to form a lashed scarf-joint type of junction with the stem or sternpost (Fig. 112 *k*). Four athwartship spreaders about 3 feet long (*m*) suggest a minimum width for the boat. A rectangular notch

* Publication authorized by the Director, U.S. Geological Survey.

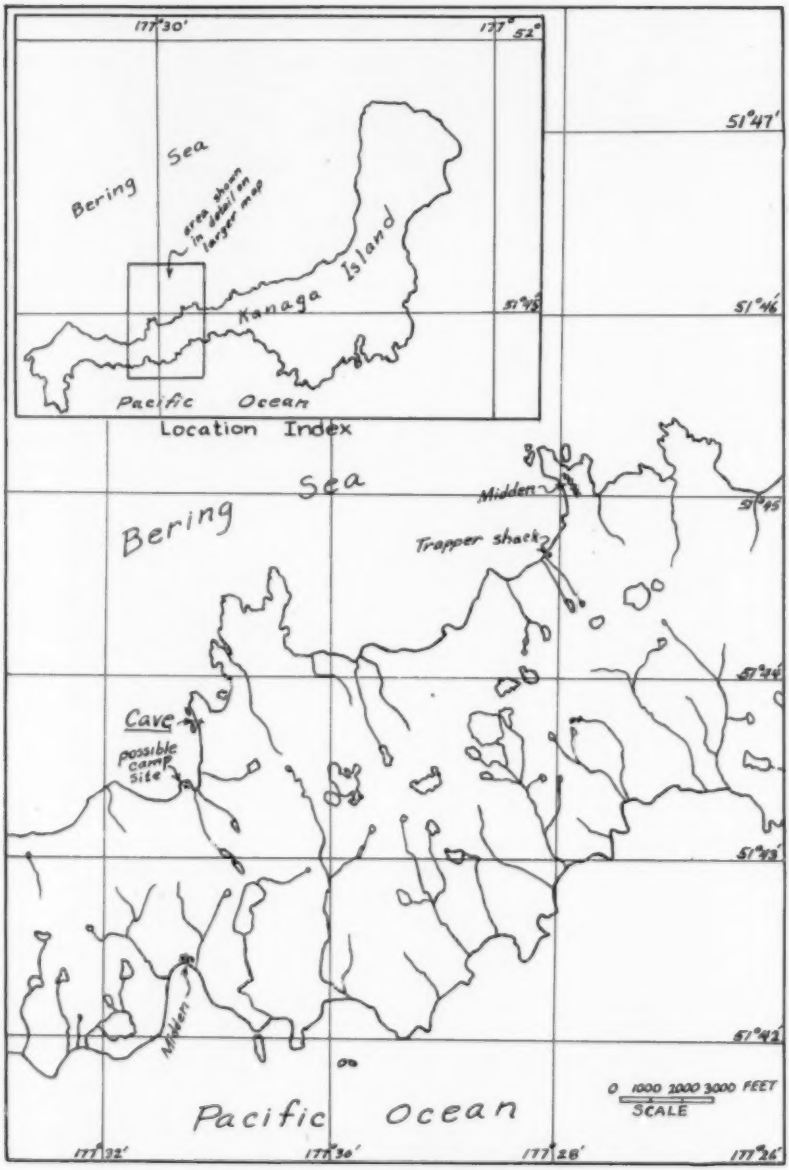

FIG. 110. Location map, Kanaga Island.

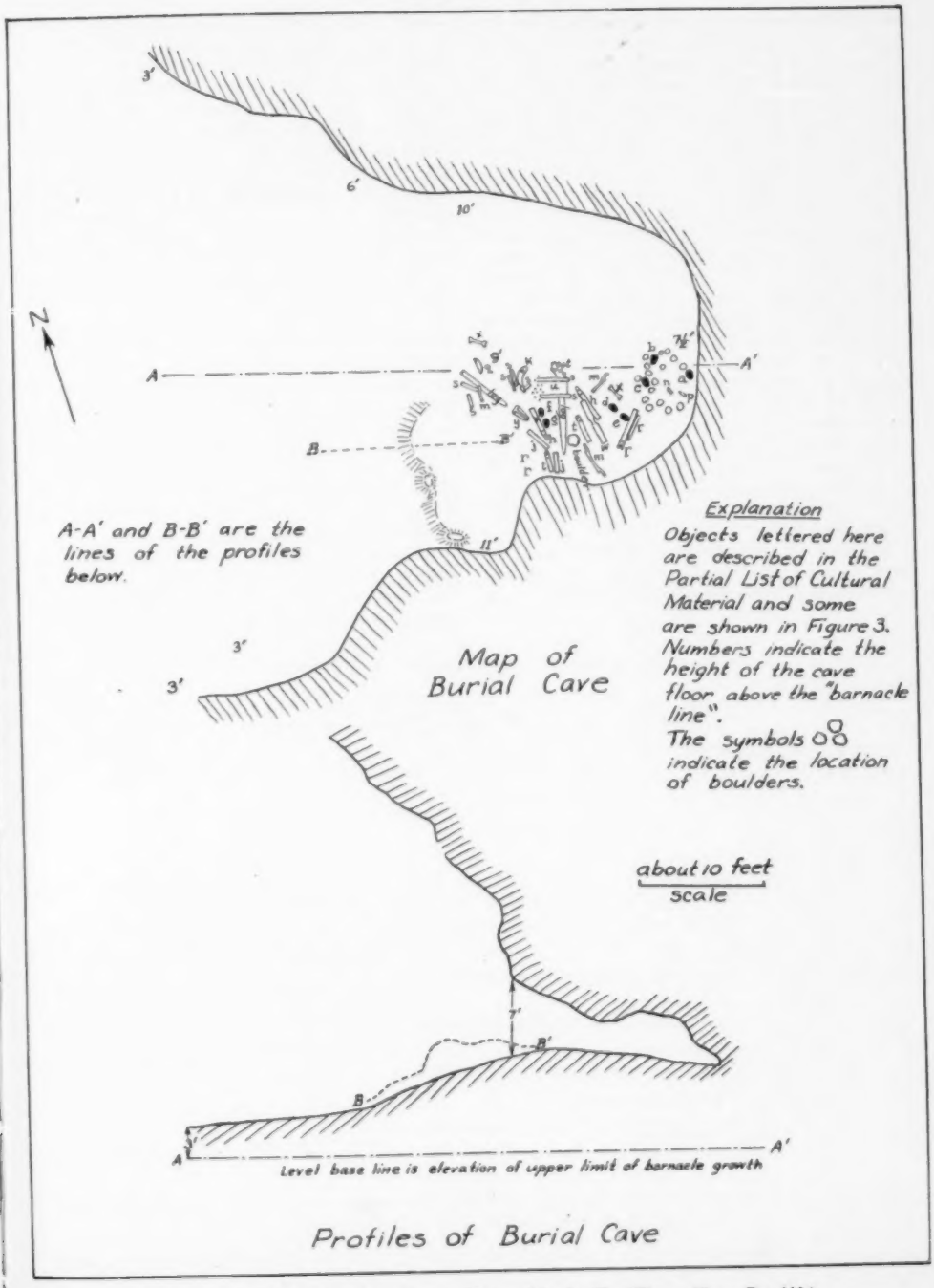

Fig. 111. Map and profiles of burial cave, Kanaga Island. (For "Figure 3" see Fig. 112.)

and 2 drilled holes at each end secured these spreaders in place by fitting and tying. Longitudinal stringers or gunwale pieces were not identified although there are several other long pieces of wood, mostly hewn.

Other wooden pieces in the cave are listed in Table 17 or shown in the figures. Together they probably represent only one essentially complete vessel, possibly lacking transverse ribs. Individually, several items illustrate technics of Aleut (?) carpentry. The rectangular notch with holes and the scarf joint show the use of lashing to secure junctions. Chamfering of the ends of boards (Fig. 112 *t*), dowels in place (*q*), and a combination of shallow notch and hole (*r*) are additional technics. No nails or other metal items were found.

The skeletal material consists of 7 human adult crania and 2 human femurs, all sound and thinly covered with moss on the upper surfaces. The advanced degree of fusion of the cranial sutures suggests late adult or senile age for the 5 crania completely visible. According to sex determinations based on comparative general massiveness of cranial and facial features, on the sharpness of the supraorbital arch, and on the development of the superciliary ridges, there are 3 males, 3 females, and 1 unknown (mostly covered). The 6 individuals identifiable as to sex lie in pairs — 1 male, 1 female — at 3 places among the rocks and wooden boat parts. The crania of each pair are less than 3 feet from one another, and all are well within the protected inner part of the cave.

On the basis of the foregoing observations, the following generalizations seem reasonable. First, inasmuch as the cave was not a likely permanent habitation, the individuals contained in it probably lived elsewhere. Second, because the individuals were aged and of both sexes, they probably were not members of a hunting or war party which met with a fatal accident at this site. Third, the paired, close-spaced arrangement of the crania suggests that the individuals were dead before their interment in the cave. Three possible explanations for the presence of the boat can be considered: (1) It was used as the burial conveyance, and was wrecked during landing operations (very possible at this place on the coast); (2) It had an entirely unrelated use, by a hunting party perhaps, with loss due to heavy seas; it is reasonable to assume that, in this case, an attempt would be made to salvage the hewn framing members; the placement of the pieces among the crania may indicate that the boat parts were put in the cave after the corpses were reduced to skeletons; (3) The boat may have been placed in the cave along with the human remains as part of the burial paraphernalia. If this is so, it should be noted that the boat parts are disarranged and are not in the positions they would occupy if the boat had fallen apart undisturbed.

Waldemar Jochelson (1925, Archaeological Investigations in the Aleutian Islands, *Carnegie Inst. of Wash. Publ.* 367) states that cave burials are often very near villages, so on that basis it is reasonable to infer that

TABLE 17. PARTIAL LIST OF CULTURAL MATERIAL (See Figs. 111 and 112)

Item	*Quantity*	*Description*
a	1	Human cranium, female?, late adult to senile.
b	1	" " largely covered.
c	1	" " male, age unknown, largely covered.
d	1	" " male, senile.
e	1	" " female, senile.
f	1	" " male, senile.
g	1	" " female, senile.
h	2 pcs.	Keel section, boat, wooden, with "Aleut" type scarf joint at one end; fits item k.
j	2 pcs.	Keel section; as above, but without joint at end.
k	1	Stem or sternpost; about 2 feet deep, with "Aleut" type scarf joint which will fit keel, part h.
m	3 complete 1 fragment	Athwartship spreaders, about 3 feet long.
n	1	Carved animal, wooden, about 4¼ inches long.
p	1	Crude point of carved bone.
q	1	Hewn board with dowel inserted into hole in edge.
r		Miscellaneous boat parts, wooden.
s		Wood pieces, hewn round; diameters range from 1½ inches to 2 inches.
t	2 pcs.	Hewn boards, each about 3 inches wide, 3 feet long; pieces may once have been a single board.
u	1	Hewn plank, about 1 inch thick, 14 inches wide; one end buried with 2½ feet exposed.
w	1	Hewn plank, about ¾ inch thick, 6 inches wide, 6 feet long.
x	2	Human femurs.
y	1	Wood object.

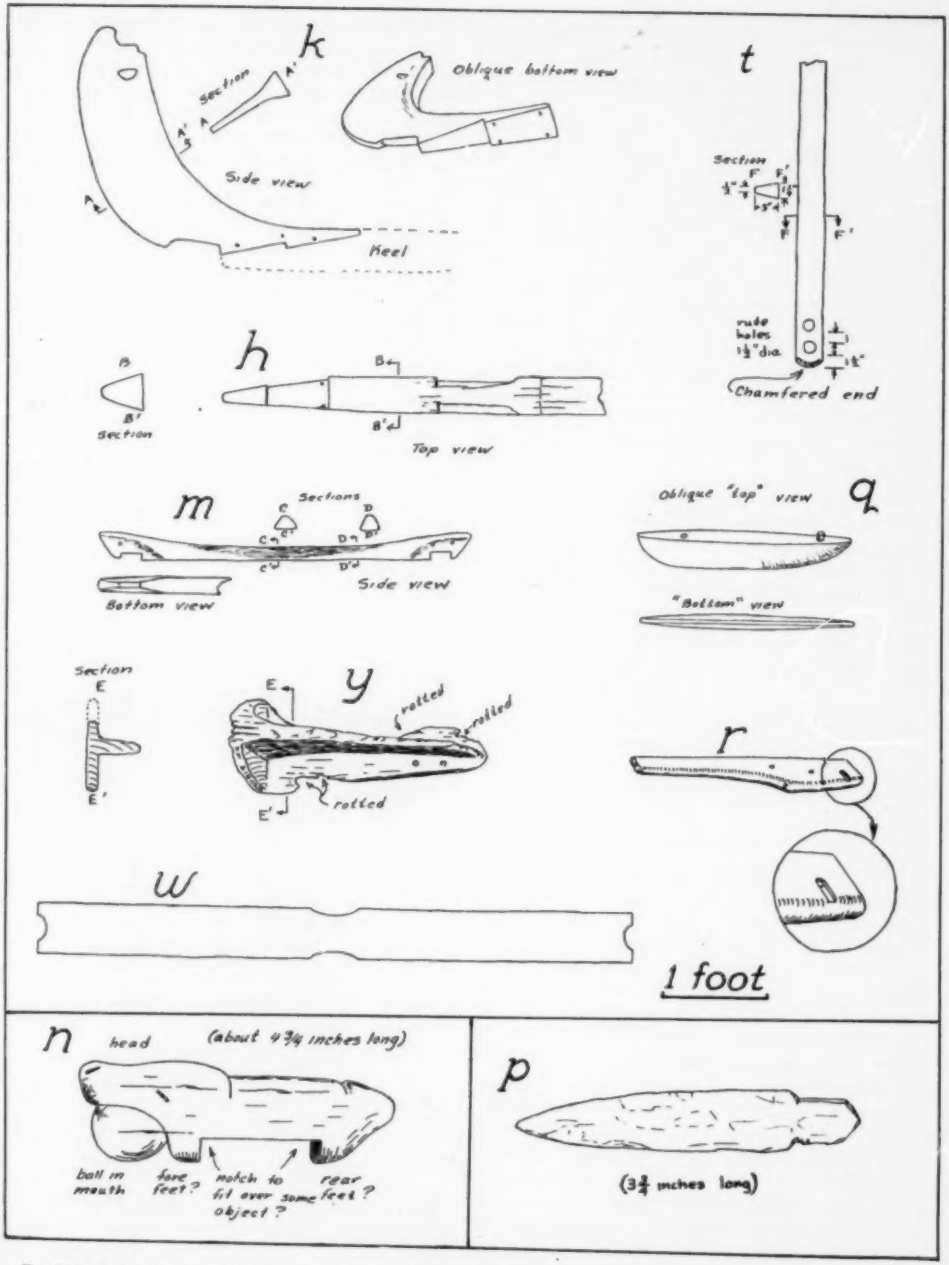

FIG. 112. Artifacts from the Kanaga burial cave. *k*, stem or sternpost; *h*, keel section; *m*, athwartship spreader; *y*, wood object; *w*, hewn plank; *t*, hewn board; *q*, hewn board with dowel inserted into hole in edge; *r*, wooden boat part; *n*, carved wooden animal; *p*, bone point.

the individuals in the Kanaga cave were from one of the nearby middens. There seldom would be any need for an Aleut group to travel far to find suitable caves.

There is little possibility of arriving at an accurate age estimate for the deposit at this time. The crania are solid, unbroken, undeformed, and only lightly overgrown with moss. Other bones are missing, except for 2 femurs. No hide or intestinal membrane remains, probably because of the action of rodents and foxes. Kelp or grass twines were not found. The wood is well preserved, with only small rotted areas. Some of the rotted areas had been covered with soil; others could have been places bruised during use. The tuff-breccia in which the cave is cut is a relatively well-indurated detrital rock that has not spalled off onto the floor to any extent, and there has been little or no ground-water seepage. In fact, the inner part of the cave is surprisingly dry in relation to the Aleutian climate in general. No excavations were made to determine the base of the cave filling.

Final interpretation of the material of the site in terms of its origin would have to be based upon laboratory studies of, particularly, the skeletal material. The age determinations for the individuals are rough but relatively certain, and the number of crania allowed an evaluation of the sex-distinguishing features. At this point it cannot even be proved that the remains are those of Aleuts, although we feel that they are.

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June, 1954

FORGED TIAHUANACO-STYLE KEROS

Well before the Spanish conquest the Incas were drinking their chicha out of big wooden cups, usually called keros. The earliest ones have simple incised designs only, but later an elaborate art developed involving lively representative designs executed in lacquer inlay in several colors. The lacquered keros continued to be made almost throughout the colonial period for use by the caciques and other comparatively wealthy Indians, and numerous specimens are known depicting people in 17th and 18th century costumes. Most of the specimens in our museums were not excavated but were acquired from descendants of the original owners who had kept them as heirlooms over a period of several centuries. While it seems not unlikely that the lacquer technic was developed before the Spanish conquest, we have no really satisfactory proof of its age, since all the pieces found in indisputably preconquest archaeological context are of the unpainted incised type. No wooden keros of any type have been found in any context suggesting a pre-Inca date for them.

In these circumstances, the existence of 4 keros decorated with incised designs in the Classic Tiahuanaco style poses a problem of great interest. If they are genuine, the wooden kero is several centuries older than we had previously supposed, and we are provided with a striking link between the Tiahuanaco and Inca cultures.

The 4 Tiahuanaco-style keros belong to the Museum of the American Indian, Heye Foundation, in New York City. They may be described briefly as follows:

15/8315. Full size kero with a design sharply incised all over the outside surface. The upper register closely parallels the famous frieze on the so-called "Gate of the Sun" at Tiahuanaco. A crack in the side has been mended with lead clamps (Fig. 113).

21/3500. A smaller specimen with Tiahuanaco designs distributed in panels. It has also been cracked.

5/9565. A small cup with Tiahuanaco designs executed in fine line incision.

5/9566. Another small cup, very similar to the preceding one.

The shapes of these specimens can be matched exactly in collections of Inca-style keros, and the wood is similar in appearance to that of Inca pieces. There are good prototypes of the kero shape in Tiahuanaco pottery, however, so the shapes of the wooden pieces are not outstandingly discordant with their designs. The designs are good Tiahuanaco in spirit and in details and would not of themselves make the observer suspicious of their authenticity.

Fig. 113. Forged Tiahuanaco-style kero (Museum of the American Indian, New York, no. 15/8315; negative 23671).

Nevertheless, a careful examination reveals that the designs on all 4 specimens are forged. They have been added to the cups after the cups had cracked and been mended. The incised lines do not go under the lead clamps on the pieces which have been repaired, and some of the lines are offset where they cross the cracks. Furthermore, the surface showing conspicuous wear on 21/3500 is rough and scored as if executed with sandpaper instead of being smooth and polished like worn surfaces on well-used Inca specimens. The forger apparently got hold of some genuine Inca-style keros which had either never been decorated at all or had badly worn designs on them, smoothed off the surface, and added the present Tiahuanaco-style decoration to increase their sale value. Blank keros are not common in museum collections, but there are some; the Museum of the American Indian has a fine one numbered 10/5858.

The identification of these 4 Tiahuanaco-style keros as forgeries removes a potential source of confusion from the field of Andean archaeology. Our information regarding the origins of the Inca kero style remains fragmentary but at least it is consistent as far as it goes. Would-be purchasers of Tiahuanaco-style keros in the future would do well to examine the specimens thoroughly before paying a fancy price for them.

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June, 1954

LAMELLAR FLAKES VERSUS BLADES, A REAPPRAISAL

A body of literature has grown up on the archaeology of the American Arctic region in recent years concerning a core and blade industry. Nelson (1937) and Rainey (1939), who were among the first writers to note the evidences there of this industry, called attention to the occurrence of "prismatic flakes" in association with prepared flint cores. The first use in the Eskimo area of the equally singular term, "lamellar flake," to my knowledge appears in Wintemberg's (1939: 89-91) paper on the Dorset Culture, wherein we find the term "lamellar flakes" used in ostensibly the same descriptive sense as "prismatic flakes." Leechman (1943: 370) discusses "laminate blades" at a later date in the Cape Dorset sites under the heading "narrow flaked blades." Although Johnson (1946) still later refers to "prismatic flakes," the die was cast and the term "lamellar flake" was adopted and accepted by some in Arctic archaeology. The term reappeared in the literature as customary usage with the increase of the finds of blades and cores, to which the writer, it should be added, was also party (Skarland and Giddings 1948; Giddings 1949, 1951; Solecki and Hackman 1951; Harp 1951; Meldgaard 1952; Irving 1953). Lately we find the term "lamellar flake" used in the title of a paper by Laughlin and Marsh (1954) in this journal.

The writer does not wish to give the impression that he is a purist, but he now feels with reasonable justification that the term "blade," or "bladelet" for small blades, might be better substituted for "lamellar flake," for the reasons given below. In the first place, to the uninitiated, the dictionary definition of "lamellar" or "lamella," a "thin plate or scale," does not convey the idea of a long, parallel-sided, thin object, such as the flints under discussion. Furthermore, the definition of "lamella" is very little removed, and in fact nearly synonymous with "squamous," meaning "scale-like," a term which is in use in Old World prehistory for very thin flakes. True, the French word for blades is "lames" (small blades, "lamelles"), but, with the exception of one paper (Okada 1951), to my knowledge there never has been a connection given between "lames" and "lamellar flakes." Old World prehistorians would unhesitatingly, upon picking up one of our New World "lamellar flakes" call it a blade, whatever its cross section. Even the use of the word "flake" in this context is a misnomer. The Old World prehistorian, very keenly aware of classificatory differences, is careful to keep apart the 2 categories, flakes and blades. By no stretch of the imagination would he call our "lamellar flake" a flake in its recognized sense (Burkitt 1949: 35-7). In Old World prehistory, flakes are to be found chracteristically in the Lower and Middle Paleolithic periods, while blades are to be found in greatest abundance in the Upper Paleolithic periods, a situation which does not concern the American archaeologist, since the prehistoric periods in America (and Greenland) have no comparable antiquity. This might be why he has been so lax in the usage of the term "flake." "Blades" and "lamellar flakes" are one and the same as I have understood them, both derived from prepared cores with striking platforms. The term "lamellar" is not known in Old World archaeology, although one may argue that there are other American terms also unknown in the Old World. However, there is no good reason, apart from the usage adopted over a period of a decade and a half, why we should continue to call blades "lamellar flakes" on this side of the ocean.

While on the subject of blades, and offered as a clue to the above problem, it appears that American archaeologists have by customary and accepted usage applied the term "blade" to finished artifacts, unifaced or bifaced, of several types, such as "knife blades," "side blades," or even just "blades,"—a very ambiguous usage. Indeed, without illustrations, the reader of a report might be lost in the blade categories. Moreover, to be technically correct, the so-called "blades" may have been originally struck off cores as flakes, a paradoxical situation. The tacit reservation in America of the term "blades" for finished artifacts of different types in the chipped flint category appears to be one reason

why the substitute term "lamellar flake" has been favored in Arctic archaeology.

What is the way out of this dilemma? Since it is envisaged that the American archaeologist will persist in using the term "blade" in a very broad classificatory sense as a catchall for some types of finished artifacts, even of ground stone, such as ulu "blades," it would seem that to discard the term "lamellar flake" for the essentially technically correct term "blade" might lead to some confusion, at least in Arctic archaeology. "Prismatic flake" is incorrect, since just as with the difficulty regarding "lamellar flakes," there is nothing flakelike about the object described. A reasonably accurate term to substitute for "lamellar flake" may be "core-blade." This, in the writer's judgment, conveys the idea of a parent core in association with the blades struck off from it. The blade was presumably struck off with the aid of a punch. Incidentally, Giddings (1952: 73, 76) has departed from the term "lamellar flake" in a recent report, adopting the term "microblade."

This might all seem like the belaboring of a small detail, but to my mind it is a detail which I now realize has been out of step with good classificatory usage, and might stand a little scrutiny and corrective action by the authors of reports touching on the core and blade industry of the north.

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August, 1954

THE RUBBER MOLD TECHNIC FOR THE STUDY OF TEXTILE-IMPRESSED POTTERY *

The custom of pressing textiles against the wet clay in the process of pottery making has a wide distribution, extending from the Eastern Woodlands in the United States to the heart of Asia. The archaeological specimens of this type of pottery enable us to reconstruct the textile technics where the textiles themselves no longer exist.

In my attempts to do such textile reconstructions from pottery impressions I have used a number of different methods: (1) water-based clay, (2) clay made with similar temper and color as the original pottery, (3) plasticene, and (4) latex mold. For the present I will limit myself to the last of these, the latex-mold method of textile reproduction. Due to the special qualities of the latex the mold that is produced can be stretched to twice its original size; this has the advantage of making the textile impression easier to study.

The latex mold is made directly from the impressed sherd. There are 3 major steps in making the mold: washing, coating, and stretching:

1. For a clear impression it is necessary to wash the sherd thoroughly.

2. A drying time of 24 hours is necessary for poorly fired or porous clay, in order to insure the removal of all moisture which would interfere with the making and stretching of the mold. After the sherd has dried the surface is coated with a thin layer of liquid latex. This coat and the subsequent coats of latex should be rubbed well into the crevices. After this first application, additional coats of latex are applied, until the mold reaches

* Paper presented to the American Association for the Advancement of Science, Section H, Boston, December, 1953.

a minimum thickness of ¼ inch. The number of coats of latex necessary to achieve this thickness will vary with the consistency of the latex. Between each separate coat there should be a drying period of at least 24 hours. Because of the drying intervals it takes about 2 weeks to make a mold. The completed mold will be in detail and size an exact positive reproduction of the negatively impressed sherd.

3. The next process consists in stretching the mold. There should be an interval of 2 to 4 days after completion of the mold before this step can be undertaken. (a) First scrub the mold thoroughly to remove particles of pottery. (b) Then completely submerge the mold in kerosene for 24 hours. During this time the mold should be turned over several times to insure even stretching. The mold at the end of the stretching period will be twice as large as the original sherd. (c) The mold should be rinsed in clear water after stretching. It is desirable to leave as much kerosene as possible in the latex to avoid shrinkage. If the mold is to be cast, it should be carefully washed in a detergent to reduce surface tension. It may be of some help to paint the mold with a surface tension reducer before casting. However, it is debatable if the detergent does not serve this function in addition to cleaning.

The latex used in my experimental work is known by the trade name of *Rubberlin* and is manufactured by the Jim Robbins Company, Stevenson Highway, 14 Mile, Royal Oaks, Michigan. However, any *pure* latex will respond to kerosene in exactly the same manner.

There are certain difficulties in making a latex mold which must be considered in order to achieve a precise enlarged reproduction from the impressed pottery. First, great care must be used in the application of the latex to the impressed surface to avoid the formation of air bubbles within the latex. I recommend that the latex be applied with the finger, using slight pressure. The finger pressure will not only work out the air bubbles but will serve also to blend the coats of latex, thus eliminating the possibility of the mold separating or peeling. Secondly, the latex must be thinly applied and allowed to dry thoroughly after each application and upon completion. Otherwise, the water within the latex will act against the kerosene during the stretching process, producing a sticky, unstable mold that will not permit handling or casting.

My experiments with this method have been with pottery from 2 areas in the eastern United States, Abbott Farm, Trenton, New Jersey, and the Angel Mounds, Evansville, Indiana. The textile impressions on the Abbott Farm material are relatively coarse and indistinct, while those on the Indiana sherds are neat and clear. The contrasting nature of these 2 wares enabled me to evaluate the method, and showed that the stretched latex was valuable in analyzing the textile impressions of both types. The accompanying photographs will illustrate this point.

Figure 114 is a fabric-impressed Middle Woodland period sherd from New Jersey (New Jersey State Museum, No. 8978), with stretched latex mold. The "Z" twist cord and the cord-wrapped stick were not clearly identifiable in plasticene; however, the rubber-mold technic permitted them to be easily discerned. I cannot positively identify the weave which is impressed on this sherd; there is the possibility of a twined fabric being the primary impression on the pot with a secondary superimposed impression of a cord-wrapped stick.

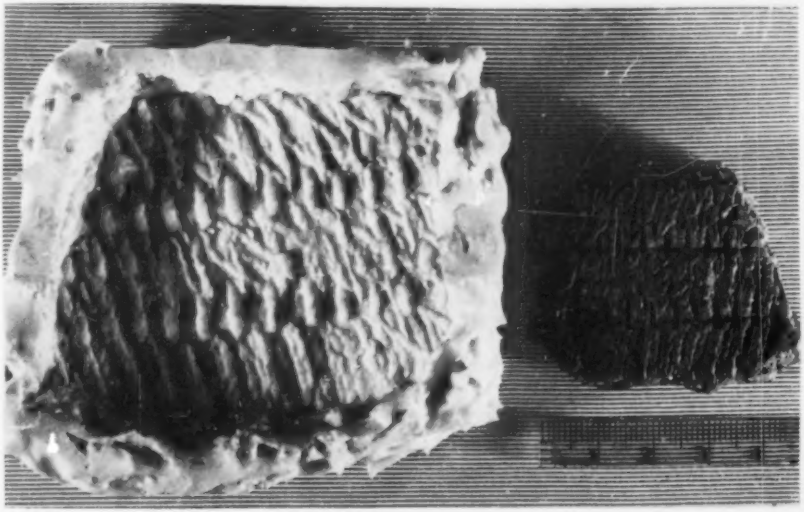

FIG. 114. Textile-impressed sherd from Trenton, New Jersey, and enlarged latex mold.

Figure 115 is a Middle Mississippi period textile-impressed sherd from the Angel Mounds site, Indiana (No. X11C/899). The fabric is clearly identifiable; however, the rubber mold technic, because of the resilient quality of the latex, permitted the recording of undercut impressions made in the sherd by the fabric, thus showing the form of the fibers and the quality of the fabric. The fabric impressed on this sherd was a simple twine with spaced, grouped warps.

A positive plaster cast of the fabric may be made from the stretched positive latex mold, but 2 castings are necessary. The 1st plaster cast from the mold will produce a negative impression. A 2nd cast has then to be made from this one in order to obtain a positive impression of the textile. The multiple castings and the inability of the plaster to record subtle details cause a loss in definition of both fabric and fibers, making the cast unsuitable for study. Further experiments with other casting mediums and different technics, for example, dental materials, may solve the problems now encountered.

The rubber-mold technic will prove to be a valuable aid in obtaining positive impressions for study of other negative impressed surfaces, such as those caused by the impressions of grain on pottery or by engraving techniques used in making seals. However, the latex, because of its adhering quality should be limited to reasonably solid, unpainted surfaces of nonperishable material.

The present status of the method leaves certain difficulties which still remain to be overcome. One of these is the fact that unless kerosene is kept in the stretched mold distortion by shrinking sets in very quickly. Secondly, the method is very time consuming. And last, the casting procedure involved in producing a permanent record of the stretched textile impression needs further improvement. However, the latex-mold technic offers the following advantages: 1st, its ability to stretch produces enlarged impressions of details which were previously indistinct; 2nd, the resilient quality of the latex permits the recording of undercut areas in the negative-impressed sherd which could not have been recorded with other materials; and 3rd, the enlarged positive latex mold permits the taking of clearer photographs as well as the use of simpler lighting and enlarging techniques. Therefore, it promises to be extremely valuable for the study of prehistoric textiles.

Acknowledgments. My interest in this subject developed at the suggestion of Junius B. Bird of the American Museum of Natural History, when I consulted him about the textile markings on some New Jersey sherds, made available to me by Dorothy Cross Jensen of the New Jersey State Museum. I also consulted with Gene Weltfish about the textile markings and she made a rough estimate of the technic involved. After a summer at Angel Mounds, Indiana, with Glenn A. Black, I returned subsequently and he kindly loaned me some textile-impressed sherds from that site. These people have continued to help me as the work progressed.

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New York, N.Y.
October, 1954

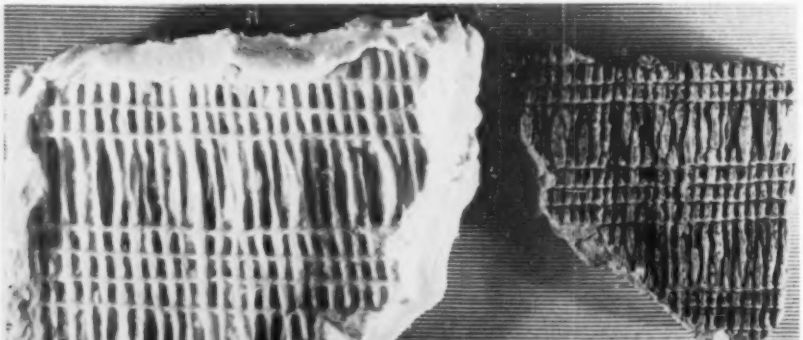

FIG. 115. Textile-impressed sherd from Angel Mounds, Indiana, and enlarged latex mold.

BOOK REVIEWS

EDITED BY WILLIAM A. RITCHIE

Archaeological Investigations in the Thule District. III. Nûgdlit and Comer's Midden. ERIK HOLTVED. Meddelelser om Grønland, Bd 146, Nr. 3, Copenhagen, 1954. 132 pp., 64 figs., 4 pls. 24 kroner (approximately $3.50).

Erik Holtved investigated archaeological remains in the Thule District, northwestern Greenland, in 1935-37 and in 1946-47. He published the results of the first expedition in 1944 (*Meddelelser om Grønland*, Bd. 141, Nr. 1-2) as I, *Descriptive Part*, and II, *Analytical Part*. He now presents the account of the 1946-47 expedition as III, *Nûgdlit and Comer's Midden*. It is an excellent supplement to Part I, and pages 95-106 contain comparative remarks cross-referenced to Part II.

Nûgdlit is a site of at least 62 house ruins on the north side of Wolstenholme Fjord at approximate latitude 76°48′N., longitude 70°34′W. The location is not mentioned in the 1944 publication; the name Ingneq (1944, Part I, Fig. 3), may pertain to 3 recent house ruins shown on Figure 3 in the 1954 publication.

"The ruins lie in three groups, each having a particular character" (p. 8). Houses 34-46 were not excavated but were identified as belonging to "late Inugsuk, or the 'late transitional' period which may be dated at about the 16th century" (p. 10). Houses 47-51, about 300 m. inland (northwest), were identified as belonging to the oldest occupation, resembling the structures excavated in 1936 at Cape Kent; these were rectangular, contained early Thule artifacts, and probably were occupied in the 12th to 13th centuries (1944, Part II, p. 12). Houses 1-33 and 52-62 were constructed by the second of the 3 precontact groups who occupied the site; 37 of these houses were excavated.

Holtved found close resemblances between the middle group of house ruins at Nûgdlit and those previously excavated at Ruinø (Ruin Island in the 1944 publication). Houses at both sites had special kitchen compartments, each containing one or more fireplaces, often to the left of the entrance passage. Each site had a 4-sided assembly house (qagsse). A variant of the Thule-3 type of harpoon heads with a knob on the spur was found at both sites.

Both sites contained a few Dorset culture artifacts (Holtved is commendably cautious in allocating specimens to Dorset Eskimo origin). Ruinø provided a number of lamellar flakes, scrapers, and other chipped implements as well as a "spatula" (1944, Pl. 1, No. 21). Nûgdlit contained one of the debatable burin-boot creaser artifacts (1954, Pl. 1, No. 20).

Several Norse objects were found at Ruinø; none was found at Nûgdlit. Holtved entertains 2 hypotheses: (1) Inhabitants of Nûgdlit may have moved north to Ruinø after partial adaptation to the local culture; (2) Nûgdlit people represented an independent immigration to northwestern Greenland, but were closely related to the Ruinø dwellers. In either case, the people "made their way eastward from Alaska, but not as the first carriers of the Thule culture" (p. 106). The 2 sites were inhabited in the 13th or 14th centuries, probably several decades either way from A.D. 1300.

Comer's Midden is the Troy of the Arctic, certainly of Greenland. It was trenched in 1916 both by Captain Comer and by members of the 2nd Thule Expedition; their findings were published by Wissler in 1918 and Mathiassen in 1927. Holtved excavated part of it systematically in 2-m. squares in 1937, and he continued the work in 1946. Section 2 of the present monograph adds descriptions of artifacts recently collected to the data presented in Parts I and II, 1944. The total number of specimens in the collection is impressive, 3299 (1937) and 1449 (1946), and the most is made of their locations and affinities. Holtved stated in 1944 that ". . . Comer's Midden represents the development right from early Inugsuk times to close up to modern times" (Part II, pp. 24-25). Other house ruins and smaller middens at the Thule (Umanaq) site provided pre-Inugsuk materials characteristic of the various waves of Thule culture carriers and of the Dorset Eskimo.

Holtved's descriptive writings are rigidly standardized, making cross reference fairly easy. Always noted is the house or midden association of a specimen illustrated or described. Tables of specimen types portray complexes and associations found in house, midden, and site as well as comparisons of materials from the different houses, middens, and sites. The plates are excellent, but there are so few of them that the author is obliged to write detailed descriptions of the types of artifacts. This he has not always done. The otherwise precise descriptive listing on page 125 of materials from Comer's Midden contains this garbled statement: "Eight pieces of *pyrites* were found in the layers 2-7, and in layer 8 a piece of wood (L 3:14675), with two deep hollows from *fire drilling* was also found."

The site ground plans and drawings are inadequate, and little clarified by the few on-the-ground illustrations. Figure 6 on page 15, "Nûgdlit, house 1 after excavation, seen from east," is conveniently opposite the ground plan of the house. Except in gross dimensions and orientation there is very little similarity between the 2 recordings of the same structure. However, it is only fair to note that weather conditions in the Thule District are not conducive to the making of plane table drawings, nor to the taking of good photographs.

Holtved deserves great credit for the *Archaeological Investigations in the Thule District*. He has surveyed thoroughly the coasts from Humboldt Glacier south to Thule. He has excavated for representation and to determine culture sequence. He prepared his monographs with careful separation of findings and conjecture, of description and interpretation. Parts I, II, and the recent supplement III, taken together, are a reconstructive study

of the remains of the various wavelets of Eskimo who reached the doorway to Greenland, and of the few Eskimo in southwestern Greenland who retraced their steps to the doorway carrying a few nicely datable Norse relics.

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Report of the Investigation of the Thomas Riggs Site, 39HU1, Hughes County, South Dakota. WESLEY R. HURT, JR. With Appendices by TODD WILLY and GLENN KLEINSASSER. Archaeological Studies, Circular No. 5, South Dakota Archaeological Commission, Pierre, 1953. v + 68 pp., 31 figs., 4 charts. $.75.

This publication is concerned with the results of archaeological excavations made in 1940, 1947, and 1952 at one of the more than 200 known Indian-village ruins that will be obliterated when the waters of Oahe Reservoir flood a large segment of the Missouri River valley in South and North Dakota.

The Thomas Riggs site lies near the edge of a high grass-covered terrace on the left side of the Missouri River, some 15 miles airline northwest of Pierre, South Dakota. Visible traces of former occupation consisted of 22 or 23 shallow, elliptical depressions roughly grouped in the form of a crescent facing the river. The largest depression was excavated in 1940 and 1947 as a project of the University Museum (now the W. H. Over Museum) of the University of South Dakota, under the supervision of Elmer E. Meleen. It held the remains of 2 long rectangular houses, designated as "House 1," and yielded pottery and some other artifacts. The archaeological data, and treering dates of A.D. 1477 to 1490 and 1502 to 1515 (or 1516) obtained by George F. Will from timbers taken from the higher and lower house floor levels, respectively, were published by Meleen in a preliminary report in this series (1949, Vol. 14, No. 4, Pt. 1, pp. 310-21).

Five additional depressions, and a 200-foot trench in the open area in front of 2 of the depressions, were excavated in 1952 as a project sponsored jointly by the South Dakota Archaeological Commission, the W. H. Over Museum, and the National Park Service, under Hurt's direction. Each depression contained the remains of one long rectangular house. The trench exposed an extensive midden deposit and 3 large refuse-filled cache pits, and showed that a blanket of windblown silt, 17 to 27 inches in thickness, had been laid down since the site was abandoned. The excavations produced pottery and other material that measurably expanded the inventory described for the site by Meleen.

The evidence as a whole indicates a single cultural unit, which Hurt calls the Thomas Riggs culture, or focus, and which he relates to several presumably antecedent, contemporaneous, and subsequent complexes now recognized in the region. The houses of the culture were semisubterranean, long, rectangular structures customarily provided with a single row of closely spaced vertical posts on each side and one center post at each end (with, sometimes, a third post near the center), suggesting the use of a gabled roof and of horizontally laid poles or mats or brush to enclose the ends; a southwest entranceway and connecting inner ramp; a large unlined firepit in the center of the floor near the ramp; and subfloor, refuse-filled cache pits on each side of the ramp and along one (south) side. Exterior cache pits, encountered in the long trench, may have occurred throughout the village area. No signs of a fortification ditch and palisade were found.

Pottery from the site — the 862 rim sherds, 10,311 body sherds, and 16 restorable vessels, all grit tempered, classified and described by Kleinsasser — consists mainly of 2 types, Riggs Straight Rim (69.6%) and Riggs Flared Rim (17.3%), both characterized by high rims with plain or incised semicircular nodes, linear incisions, or punctations on the lip; smoothed or burnished bodies, and occasional loop handles. Other rim types include Riggs Punctate (3.7%), with high straight or flared rims and punctated lips or punctated fillets applied to the exterior rim surface; and 4 types with S-shaped rims, Fort Yates Cord-impressed, Aldren Cord-impressed, Riggs Incised, and Riggs Plain, which together account for 9 percent of the classifiable rim sherds. The majority of the body sherds are smoothed (64.2%), simple stamped or "ridged" (31.4%), and incised or trailed (3.6%).

The sherd material classified by Kleinsasser as "Fort Yates Cord-impressed" does not fit this type as originally defined by Gordon W. Hewes, but the material designated as "Aldren Cord-impressed" appears to be identical with the Fort Yates Cord Impressed of Hewes. Under the circumstances, it would be well to withdraw the name "Aldren Cord-impressed" and to assign a new name to the non-Fort Yates Cord Impressed sherd material.

Artifacts other than pottery, described by Todd Willy, include such items as side-notched projectile points with convex sides and straight base; asymmetrical leaf-shaped knives, and knives made of platy slabs of vein chalcedony; planoconvex, subtriangular end scrapers fully retouched on the convex face or along the working edge and sides only; ground celts; grooved mauls; shaft smoothers; bison-scapula holes with the head intact and with the spine and the acromion removed; bison-scapula knives; bison horn core "root diggers"; fleshers of split bison metapodials with or without the distal end; arrowshaft wrenches of bison ribs; awls of split deer or pronghorn metapodials; bone fishhooks; and clay pipes, one of which is elbow shaped.

Faunal remains and artifacts indicate considerable dependence on hunting (mainly bison), and some fishing and gathering. Domesticated plant remains were not recovered, but the presence of numerous cache pits and of hoes, "root diggers," and scapula knives implies that horticulture was also an important feature of the economy.

Considering house form, artifact complex, and subsistence pattern, Hurt assigns the Thomas Riggs culture to the "northern complex" of the Middle Missouri phase. This division includes the unfortified Fort Yates and the fortified Huff sites (or "foci") in southern North Dakota. On the basis of close similarities in the pottery of the Thomas Riggs and Fort Yates sites, the date of A.D. 1350 to 1450 suggested by Gordon W. Hewes for the Fort Yates site, and the treering dates given by Will to timbers from the Thomas Riggs site (which must be regarded as tentative until they have been checked by specialists), Hurt postulates that the Thomas Riggs culture represents a migration down-river from the Fort Yates locality about A.D. 1475. Certain of its traits, notably simple stamping, were passed over to the culture of the fortified Arzberger site below Pierre, which seems to exhibit Upper Republican affinities in house form and artifact material and is considered to represent a late upriver movement of Upper Republican peoples. In time, Hurt believes, the Thomas Riggs culture diffused upstream to the Swan Creek, Rygh, and Huff sites, in northern South Dakota and southern North Dakota, under pressure from the cultures manifested at the La Roche and Myers sites, on the west side of the Missouri, below and above Pierre, respectively, which appear to stem from the Arzberger culture. These hypotheses will doubtless be subjected to rigorous testing by other workers in the near future.

Hurt and his associates are to be commended for producing a report in less than a year after the completion of the field work which furnished most of the data. In view of publication requirements, they may be forgiven for the high incidence of typographical errors, far in excess of the 6 errata listed on the slip accompanying the report, and for the many errors in the references to their illustrative material and to the literature.

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Prehistoric Indians of Wisconsin. ROBERT E. RITZENTHALER. Popular Science Handbook Series No. 4, Milwaukee Public Museum, Milwaukee, 1953. 43 pp., 113 figs. $.60.

This well-illustrated booklet was prepared as a popular introduction to Wisconsin prehistory. Following a short introduction presenting the nature and methods of archaeological research, 5 Wisconsin cultures (Old Copper, Woodland, Hopewellian, Upper Mississippi, and Middle Mississippi) are described. Representative series of artifacts and site features are shown for each cultural complex. A few line drawings are utilized to illustrate manufacturing processes and a photograph of a Chippewa wigwam is given to indicate the probable nature of Woodland houses. A subsequent section describes the nature of the information that may be derived from skeletal material.

While it is probable that other students of Wisconsin archaeology might use a somewhat different framework for the grouping of the cultures or slightly different terminology, these are matters where there are still differences of opinion. A brief, clearly written account, such as the booklet under review, presenting a basic introduction to a regional archaeological field requires considerable simplification and omission of technical detail. The suggestion, stressed in both the introduction and conclusion of the booklet, that finds of burials and artifacts are important and should be reported to archaeologists at museums and universities may encourage the recovery of additional information. Ritzenthaler's presentation of what is not known in Wisconsin archaeology may serve to stimulate interest in the field as a continuing branch of study. Far too few regions have such a popular handbook to awaken the interest of state residents and to acquaint the novice with the nature of regional archaeology. It should be emulated.

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The Excavation of Pindi Pueblo, New Mexico. STANLEY A. STUBBS and W. S. STALLINGS, JR. Monograph, No. 18, School of American Research, and the Laboratory of Anthropology, Santa Fe, New Mexico, 1953. 165 pp., 70 figs., 40 pls., fold-in plan. $6.00.

This is a complete, carefully prepared site report describing in detail the work undertaken at this large village typical of the black-on-white period for this general north-central New Mexico area of the late 13th and early 14th centuries. Pindi Pueblo, located 6 miles below Santa Fe on the north bank of the Santa Fe River, was named from the Tewa word for turkey because of the many evidences of domestic turkeys found there. It is a privately owned site, and the owners wished to exploit it commercially, so after excavation the adobe walls were left exposed. Subsequent erosion, both by the Santa Fe River, which washed away about half of it, and by ordinary weathering of the walls, has drastically reduced this site. Since the work was undertaken with CWA and PWA labor, extensive excavation was possible.

Much of the work is concerned with the internal cultural and chronological relationships of the pueblo, and its relationships to other sites. Some of the most careful work deals with the determination of construction sequences, with sections and diagrams to illustrate the general conclusions reached. Four cultural divisions are distinguishable at this site: (1) a pre-Pindi period, represented ceramically and by 2 jacal structures found under the pueblo; (2) the first building period, which was fairly long, and was represented by multiple unit type structures, and 3, or possibly 4 kivas; pottery is largely Santa Fe Black-on-White; (3) the second building period, indicated by a rapid expansion of the pueblo; pottery of this period is characterized by the rise of Galisteo; (4) the abandonment of portions of the

pueblo, and the construction of other parts; this last period is indicated by the rise of Wiyo pottery.

This report is a very interesting example of correlation by seriation of treering dates, ceramic sequences, stratigraphy, and architectural developments. As a result dates, in terms of our own calendar, have been applied to the various divisions. For the pre-Pindi period 2 dates, both in the early 13th century, were secured. The first general ceramic period is dated from 1250 to 1300, with a concentration of dates between 1270 and 1289. The second broad ceramic period dates from about 1300 to 1350 and is referred to as the post-1300 period.

One section of the report is given over to a detailed presentation of architectural construction details, including some very interesting kiva types. The chapter on ceramics is also a very complete presentation, with very good halftone illustrations of pottery types, which supplement the descriptions published elsewhere by Shepard. Additional ceramic data include extensive and intensive analysis of body forms, rim forms, layouts, and designs. Trade pottery is also identified and presented by percentage, to show extent and direction of trade contacts. The description and analysis of artifact types is organized, as usual, by grouping the objects according to the materials of which they were made. Such categories as clay objects other than pottery, stone, both chipped and ground, bone, shell, and perishable materials are discussed. Small clay animals and tubular pipes are distinctive. Projectile points are of the small triangular, often laterally notched, types so characteristic of later North American cultures in general. Axes are full grooved, as are mauls, and developmental sequences have been suggested for them. There is a very thorough analysis of mano and metate types, and a most interesting discussion of bead and pendant manufacture. Bone awls are mostly of the very long and slender type, and the heads are often worked down. There are also bone beads and whistles. Shell seems to have been used largely for beads and pendants. Perishable materials includes basketry, shown by impressions on pottery, matting, sandals, and feather cloth. Botanical specimens, largely foods, were also carefully collected and are identified, listed, and discussed.

There is a section on burial customs, and some comments by Howells on 12 crania types similar to the Pecos population. Burials are flexed or semiflexed and seem to have been distributed haphazardly throughout the site. Very few of the burials had any grave goods with them, and most of the bones were in fragile condition.

Two of the most informative sections, though very condensed, are found in appendices. Appendix A is a summary of northern Rio Grande archaeological history, and is written by Stubbs. It consists only of 3 pages of text, one map, and a fold-in chart, but it is very concentrated information. The map shows pottery type distributions and the directions of their movements and influences. The diagram is a time-pottery type chart which is loaded with information. The text is a summary of Pindi in relation to this broader Southwestern history and is an excellent concise characterization. No such generalization as this can ever be complete and final, and Stubbs is well aware of this, for in an addendum he explains that subsequent work has contradicted some of the ideas expressed in his summary.

Appendix B is a compilation of 195 treering dates, prepared by Stallings. These are arranged in the order suggested by the building sequence and the ceramic periods. In general the dates and these other sequences correlate very well. This reviewer would like to remind the reader that before these dates could be determined it was ncessary for Stallings to build a Rio Grande chronology, a project of no small proportions. Such a presentation is an invaluable, and in fact necessary portion, of any Southwestern archaeological report of this nature.

In general this report is very complete and very ably presented. The illustrations are well selected, planned, and reproduced. The organization is good, with a preliminary statement in the form of generalizations about chronology and culture, followed by a presentation of evidence, and a general summary statement. The authors are well aware that this work is not directed to a new or unique problem, but rather to the addition of general information about a rather well-known phase of Southwestern prehistory. This well-rounded report adds materially to previous work done here, on this general period and culture. It is therefore a bulletin which every serious Southwestern archaeologist must have in his library, and it should be in the libraries of universities and other organizations in any way interested in the Southwest. It is the kind of careful, sound work and reporting which is of permanent worth.

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Tlaxcala in the Sixteenth Century. CHARLES GIBSON. Yale Historical Publications, Miscellany LVI, New Haven, 1952. xvi + 300 pp., 6 pls., 8 tables, 5 maps. $6.00.

Of significance and interest for both anthropologists and historians, dealing particularly with acculturation, this book has been very favorably reviewed by specialists in several journals. Lesley B. Simpson (1953, *Pacific Historical Review*, Vol. 22, No. 1, pp. 53-5) calls it "a model of intelligent research and uncluttered presentation" and accepts Gibson's reduction to 500,000 of his preconquest population estimate of 750,000 (S. F. Cook and L. B. Simpson 1948, *Population of Central Mexico in the Sixteenth Century*, Berkeley). Russell Ewing (1954, *New Mexico Historical Review*, Vol. 29, No. 3, pp. 240-2) also praises the work very highly, and summarizes major findings on Spanish and native political organization and governmental practices. The presentation and handling of data on culture contact and acculturation are emphasized, and commended, by Edward H. Spicer (1953, *American Anthropologist*, Vol. 55, No. 3, pp. 425-6). Obviously this book is a contribution of

major significance, essential both for students of indigenous and Spanish history in colonial Mexico and for all anthropologists interested in process, culture change, and acculturation.

Attractively presented as to format and type, and generally quite readable, it summarizes and exemplifies the contact situation in Mexico following the conquest, with special attention to native self-government organization under general Spanish direction. Religious activities and economic life are discussed. Colonization by Tlaxcalans in the north, in Coahuila and Texas, is briefly treated. The final "Conclusion" is a penetrating interpretation with broad implications for the understanding of human history in the Western Hemisphere.

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Interpretacion del Codice Gomez de Orozco. ALFONSO CASO. Talleres de Impresion de Estampillas y Valores, Mexico, 1954. 20 pp., illus.

Wide comparative knowledge of the codices and a painstaking commentary were to be expected from Caso. To these are added as a very pleasant surprise one of the finest reproductions of any native manuscript which has yet appeared. There has obviously been none of the schematization which mars some of the more famous codex reproductions. The colors likewise seem intended to reproduce faithfully the present condition of the fragment, rather than to represent the presumed intention of the original painter. Generally speaking, manuscripts which have been reproduced in the United States have been poor, and those reproduced in Mexico worse. We can only hope that this study will set a new standard for Americanists everywhere. As befits such a study, the binding is handsome and the paper of the text is good. Even the black and white photographs show legible reproductions of comparative material, rather than the dim blurs over which Americanists have too frequently had to strain their eyes in the past.

A scholarly and thorough study of a hitherto unknown manuscript fragment, this work leaves a reviewer with nothing which can legitimately be criticized. The manuscript deals with the cosmological beginnings of the history of an unidentified native kingdom of the Mixtecs of Oaxaca, in southern Mexico. Caso shows that one side duplicates the material of the *Rollo Selden*, while the other side begins a dynastic list of persons known, in large part, from the *Lienzo Antonio de Leon* (also known by several other names, including *Lienzo de Chicomoztoc*).

The fragment is not of major importance, since the total preserved section comes to only 3 pages and most of the material is also found in other manuscripts, but it helps to tie 2 groups of manuscripts together and gives us an idea of the permissible latitude which the artist-historians had in presenting their data. The data not found elsewhere are restricted to a notation of 2 rulers and their kingdoms or kingdom. A place called Bent Mountain (Aztec Culhuacan) is shown, accompanied by a lord, One Wind. This might be of considerable importance if more of the fragment were known, as Culhuacan figures importantly in Aztec legend.

Caso believes that Lord Eleven Serpent, who appears to the left of One Wind, is also a lord of Culhuacan, and does not mention the alternative possibility that the name "Cañas" (Reeds, a glyph associated with Eleven Serpent) may be a place name rather than a surname. In pointing out that this fragment seemed to be the same as one described by Lehmann as the *Fragmento Doremberg*, Lehmann is quoted as saying that there was a glyph like that of Tollan (Tula) associated with Lord Eleven Serpent. The glyph actually seems more like that of Acatlan than Tollan but the association with Culhuacan suggests that this may actually be a place glyph of Tollan, since Culhuacan and Tula are often associated in native writings. Even one more page of the manuscript would probably have solved this problem and given valuable information about the legendary Bent Mountain.

The thoroughness of the study will be clear from the fact that this relatively minor point is the only one about which I feel more discussion would have been helpful, and the only one in which I am doubtful of Caso's interpretation.

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El Pueblo del Sol. ALFONSO CASO. Fondo de Cultura Económica, Mexico, 1953. 125 pp., figs., 16 pls.

El Pueblo del Sol, to be translated as "The People of the Sun," becomes the best available summary of the whole complex and confusing subject of Aztec religion. It is a partially rewritten and a considerably expanded version of Caso's earlier booklet, *La Religión de los Aztecas*, 1936, an English version of which was published by the Central News Company of Mexico in 1937 under the title, *The Religion of the Aztecs*.

Like the earlier version, this book is intended for the general reader, but as there are few who control the involved and often contradictory sources from which our knowledge of Aztec religion comes, the general reader in this instance will include most students of the American Indian cultures. It seems to be one of those happy instances where a "popular" book is written by a pre-eminent authority on a particular subject and, as a very usable summary of his extensive and specialized knowledge, it comes to be one of his most valuable contributions. This is most likely to happen of course when a scholar, like Caso, is able to write in a simple and very lucid style.

The book is a delight in other ways too. Handsomely designed and printed, it contains within the text a number of sparkling multi-color reproductions from the codices, prepared by Miguel Covarrubias, as well as one original reconstruction drawing of the great temple at

Tenochtitlán. At the back of the volume are 15 photographic plates of important Aztec sculptured objects.

Footnotes and bibliography are completely lacking and this will be a handicap for the beginning student who would like to use this book for an introduction to further reading on Aztec religion. There was good reason to exclude them, perhaps, for the adequate documentation of any statement on Aztec religion must be terribly complex and this would have made the book something other than a simple and interesting account of the subject.

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Die regionale Verteilung von Schmuckelementen im Bereiche der Klassischen Maya-Kultur. WOLFGANG HABERLAND. Beitrage zur mittelamerikanischen Völkerkunde, II. Hamburgischen Museum für Völkerkunde und Vorgeschichte, Hamburg, 1953. 7 pp., 6 pls., 1 table, 1 map.

This paper is an extract from a thesis presented by Haberland in 1952 before the faculty of the University of Hamburg. It summarizes very briefly the method and some of the results of his work. The author has attempted by a detailed analysis of body ornaments shown on sculptured Maya figures to define regions of stylistic unity within the Maya area and to show the degree of their mutual influence at different periods of time.

The paper is chiefly of interest because it is an experiment in method and there may be differences of opinion as to its success. My own impression is that Haberland's method is too rigid and too precise for the type of material he handles and for its distribution. His distinctions of forms are in some instances absurdly minute and the resulting "types" (variations) occur too infrequently to be statistically handled. The percentages in his chart, with a very few exceptions, are based on such small figures that they are meaningless.

With such data, the uneven distribution of the material in time tends to distort the results and there is some indication that it has done so. For example, Haberland's Central Province is limited to the sites of Uaxactun, Tikal, and Uolantun, where there is an apparent concentration of early monuments, and where the Period of Uniformity (9.12.0.0.0 to 9.16.0.0.0) is very poorly represented. Naranjo, where, on the other hand, monuments tend to cluster around the date 9.14.0.0.0, is placed in a different province. It is not clear if any consideration was given to this peculiarity of time distribution, which is at least in part due to the vagaries of natural destruction of monuments and to incomplete exploration.

One feels that a more comprehensive coverage of traits and a less minute treatment of detail would have given more reliable results. Nevertheless, some of Haberland's conclusions are confirmed by other archaeological researches and if suitable corrections can be devised for the flaws of distribution, his approach may be developed into a useful tool for the study of the conditions of communication between various parts of the Maya area. His compilation of illustrations of Maya ornaments is convenient for rapid trait comparison within the somewhat narrow range it covers. The sources of the individual illustrations, unfortunately, are not given.

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The Ruins of Zaculeu, Guatemala. RICHARD B. WOODBURY AND AUBREY S. TRIK. With an introduction by John M. Dimick; special contributions by Charles Weer Goff, William C. Root, T. Dale Stewart, and Nathalie F. S. Woodbury. United Fruit Company, Boston, 1953. 2 vols., xviii + 466 pp., 2 frontis., 297 figs., 13 tables, 3 maps.

Most archaeologists who pick up these clothbound boxed volumes for the first time will experience an envious twinge as they contrast their elegance with the modest paper-backed, often offset-printed monographs that have become almost standard fare these days. For *The Ruins of Zaculeu* is published in the all but disappeared grand manner of 50 years ago, but in modern double-column format. It is an important collection of archaeological reporting: sober, sound, exhaustive, well organized, and sprinkled here and there with just enough interpretation to make the reader wish the authors had not been quite so conservative in this respect.

The book begins with an informally written history of the Zaculeu project by its Director, John M. Dimick. Here again we are reminded most pleasantly of the reports of yesteryear, when the Malers and Maudslays of those apparently more congenial days flavored their monographs with day-to-day minor adventures and anecdotes. The project was methodically organized and diligently executed, a credit to Dimick's direction and to the work of his staff. Chapter II is a history of Zaculeu, compiled by Nathalie Woodbury, from the pre-Conquest legends recorded in native annals to the Spanish-recorded invasion and subsequent reduction of the area by the Alvarados. It is a painstaking and thoroughly competent study, and is frequently linked with the better known Quiché, Zutuhil, and Cakchiquel histories. Chapter III, by Trik, is a concise description of the site and its environment.

The bulk of Volume I (II contains the photographic illustrations) is divided between 2 main chapters, "Architecture" (pp. 24-75, by Trik) and "Artifacts" (pp. 116-283, by Woodbury). These 2 sections are structured chronologically in a sequence of arbitrarily named "phases," conceived in the rather general Mesoamerican archaeological tradition of time periods having some cultural distinction based largely on ceramic typology. The Atzan, Chinaq, Qankyak, and Xinabahul phases belong respectively to the latter part of the Early Classic, the Late Classic ("Tzakol" equivalence on p. 42 is

an obvious slip of the pen), post-Classic Tohil plumbate horizon, and the immediate pre-Conquest period. Trik further describes the major structures by building or occupation periods assigned to the above phases. One's first reaction to this long and detailed chapter may be a wish that the data could have been presented in an outline form which would enable the reader more easily to select the subject matter in which he might be interested, — a form comparable to that used in the grave and pottery descriptions, and so well utilized architecturally by A. L. Smith in his final Uaxactun report. However, outline presentation requires that all comment and discussion be segregated, and one of the beauties of Trik's chapter is his readiness to interpret individual features as he goes along. Choosing as a random sample the first 4 pages, we find, for example, comments on the builders' motives in burning a floor (p. 26), the probable function of various units (p. 27), advances in technology as revealed in finish, hardness, and ingredients of the building materials (pp. 27, 29), the possible provenience of these materials (pp. 27, 28), inferences regarding human sacrifice (p. 28), and burnt offerings (pp. 29, 30). All these bring to life what would otherwise be a deadly static report, and they reveal that Trik constantly kept in mind the human beings who practiced the culture, and who made and occupied the structures it was his task to excavate and restore.

The architectural drawings are excellent and the grave drawings are clear, obviously accurate, and most realistically rendered. With a very few exceptions, on the other hand, the photographic halftones in Volume II are of inferior quality, or rather it appears that the original photographs were not too good. In this one respect the book does not live up to the elegant tradition of the early works to which we have compared it.

Woodbury's section on artifacts is a model of good presentation. He defines his terms so there is no confusion on meaning or implications of "phases," pottery "types," and so on. The latter are not based exclusively on surface color, form, or decoration, but on any one or combinations of such features as make the group distinctive. Introductory summaries and concluding comments are segregated from minor subject matter. Statistics are not lacking, except for percentage frequencies, which are of little importance anyway when one is dealing largely with grave and cache furniture. The drawings are excellent; the halftone reproductions in Volume II range from adequate to very good. I kept a list of artifact data that seemed to me to be of considerable significance, but it became too lengthy to include in this review. Samples: a brown "flower pot" suggestive of pre-Classic Miraflores phase suggests that the break between pre-Classic and Classic times was not so complete at Zaculeu as has been pictured elsewhere (my Balam phase at Zacualpa led me to a similar conclusion); pseudo-animal head feet in Atzan phase may have been a forerunner of the post-Classic moldmade supports; censer spikes, thought by Dieseldorff to represent sun rays, more likely simply protected the bearer's hands from the heat of the burning contents; alloying of silver and copper was practiced; cloth imprints on jar interiors suggest a wrapping to keep the clay from sticking to the mold. These stimulating comments and suggestions are numerous.

A summary of important traits by phases, by Woodbury and Trik, appears near the end of the text. Following it are chapters on anthropometry of the Mam, on skeletal remains (Stewart sees in changed headshape styles a reflection of "population and cultural upheavals on a grand scale" at the close of the Classic period, and finds no evidence that any of the burials were sacrificial victims), and on new evidence of pre-Columbian bone syphilis.

There is little or no historical or ethnic speculation in the summary of traits or the supporting chapters. One finds a brief suggestion that Xinabahul phase may represent a Quiché contact, another that Kicab II may have taken Zaculeu and added to it at one time, and a note that Qankyak phase may reflect sudden Mexican influence. There is no attempt to apply Zaculeu's rich architectural record, its lavish funeral practices, its art styles, and its anthropometric data, etc., to the problem of the postulated sociopolitical revolution at the close of the Late Classic, or to the nature of the Reformulation period which followed in both Mesoamerican and Andean prehistory. The authors show imagination and skill in their inferences and deductions regarding individual cultural traits, but they leave to the reader the task of molding these into a meaningful pattern. I consider the Zaculeu project physically well planned, efficiently executed, and, from this point of view, admirably reported, but the reader must not have his hopes raised too high by Dimick's Introductory justification of archaeology in terms of what it tells us of human behavior and its repetitious if not cyclical progress, or by his references to cultural curves "not forever in ascendancy." The Zaculeu report does, however, fully live up to Dimick's more specifically expressed goals: to afford our students documentation in history, and provide an addition to "the great library of detailed anthropological studies . . . a challenge to further effort."

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Excavations at Wari, Ayacucho, Peru. WENDELL C. BENNETT. Yale University Publications in Anthropology, No. 49, New Haven, 1953. 126 pp., 21 figs., 12 pls., 8 tables. $3.00 (bound with No. 50).

Wendell Bennett started his all too brief but extraordinarily productive career in Andean archaeology with a series of stratigraphic test pits at the key site of Tiahuanaco in 1932. On his final field trip, in 1950, he dug a number of stratigraphic test pits in and near Wari, a site that in the intervening years has been recognized as of major importance in determining the course and nature of the diffusion of Tiahuanaco ideas

over a large part of the Central Andes. In *Excavations at Wari*, as in *Excavations at Tiahuanaco*, he presents a brief description of the site, an account of pit excavation, and an analysis of the collections, consisting almost entirely of potsherds. In contrast to the Bolivian report, this monograph contains much more discussion of relationships, both local and regional. This is possible partly on account of the discovery of much new material in the past 20 years, but even more because, unlike Bolivian Tiahuanaco pottery, many Wari wares can be clearly related in style to those on or close to the Tiahuanaco horizon on the Peruvian coast and in parts of the highlands.

Wari is a large site; its "major core" covers an area at least 1.5 km. square. Bennett made a sketch map, which he states is "hurried and inaccurate," but this, with 2 plates of views and details of the rough stone walls and the few concentrations of dressed stone work give an impression of a very important regional center. Although few houses could be identified, the town must have had a considerable population.

Dressed stone, suggestive of Bolivian Tiahuanaco, may represent an earlier construction period than the rough stone walls, but any architectural sequence and the association of statues (also suggestive of Tiahuanaco) with the pottery sequence would require intensive and probably lengthy excavation. There is still, therefore, much to be done at Wari, including a search for burials, none of which Bennett found in the refuse in which he dug 15 pits.

Bennett also dug briefly at Acuchimay and Conchopata, 2 sites nearer Ayacucho than Wari. His analysis of over 62,000 sherds, summarized in a strip chart shows the local relationship of 4 major ceramic groups. They are all present throughout the time span covered by the excavations, but clearly changing relative frequencies enabled Bennett to describe "two major periods and an intermediate phase." The earliest is the Wari Period, in which he places both dressed and rough stone masonry, statues, and some minor nonceramic artifacts. Pottery is dominantly of the Wari series, of which the Polychrome and Polychrome Fine are most useful for comparative studies. These wares, especially the latter, are clearly in the Tiahuanaco stylistic tradition, and differ from Bolivian Tiahuanaco in much the same way that coastal Tiahuanaco (called Peruvian Tiahuanaco in this report), differs from Bolivian Tiahuanaco. Bennett states: "The Wari designs are most closely related to the Tiahuanaco stonecarving designs, which in turn suggest textile patterns. This suggests the Tiahuanaco design spread may have been through textiles." This is strikingly illustrated by some Wari Polychrome sherds with diagonally divided panel designs that virtually duplicate a common design in coastal Tiahuanaco tapestries. Wari polychromes in general are closer in appearance to coastal Tiahuanaco pottery than to anything else, but, as Bennett points out, the total Wari assemblage is not represented at any coastal site.

Bennett calls the culture of the Wari period "the most complete unit of the Peruvian Tiahuanaco yet found." This raises the question of whether Wari was the center of distribution of Tiahuanaco ideas, and if so why only the polychrome style spread to the coast. He tentatively answers these questions by a series of interesting hypotheses, the first involving the religious influence of Tiahuanaco on the local and as yet undiscovered pre-Wari culture of the Ayacucho region. This would account for the dressed-stone masonry, statues, and textile-derived pottery designs. From Wari the same Tiahuanaco religious symbols were spread widely in Peru, in the form of textiles and ceremonial or mortuary vessels. Presumably this expansion of the cult of Tiahuanaco was militarily assisted. It is a logical explanation of the apparent selectivity in the whole movement of Tiahuanaco motifs. It would be strengthened if the first steps in the expansion in and beyond the Titicaca Basin could be traced. I, therefore, quite agree with Bennett that it seems unlikely that strong Tiahuanaco influence reached Wari without leaving a trace in the northern Titicaca Basin and beyond, especially in the Cuzco Basin.

For the general reader, the intermediate phase and the late Huarpa period are of less interest than the Wari period. Ayacucho Polychrome, closely related stylistically to Nazca Y, is at the peak of its popularity in the intermediate phase, although it occurs in small percentages throughout the Wari period. Bennett suggests that the lack of textile counterparts of Ayacucho Polychrome design, as opposed to those of the Tiahuanaco-inspired textiles, may explain the limitation of its coastal distribution in comparison to that of coastal Tiahuanaco. Since Nazca Y (or Ayacucho Polychrome), was more popular in the Nazca region than to the north and south of it, and since Conchopata Polychrome, found throughout the Wari period, corresponds closely to the Pacheco urns from Nazca with their striking Tiahuanaco stone carving motifs, a direct and strong influence from Wari on Nazca seems evident.

The late pre-Inca Huarpa period is marked by additional pottery series, including a black-on-white ware that suggests Late Chancay, and other local styles derived from Ayacucho Polychrome. Much of the rough stone construction at Wari was apparently done during this period. The site was abandoned before or during the Inca conquest, since no Inca ware was found in it.

This review provides the merest sketch of Bennett's results. Like his Bolivian reports, it will remain a basic source. The general reader will find the illustrations, summaries, and interpretive discussion useful. For the specialist it is essential.

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On the Excavation of a Shell Mound at Palo Seco, Trinidad, B.W.I. J. A. BULLBROOK. Appendix by Irving Rouse. Yale University Publications in Anthropology, No. 50, New Haven, 1953. 114 pp., 13 figs. $3.00 (bound with No. 49).

This excellent report on the excavation of a shell mound in Trinidad is an extraordinary document for reasons that have nothing to do with the material obtained or the importance of the results. Mr. Bullbrook, a geologist, did the work and wrote his report in 1919. For various reasons it was not published, as had originally been planned, by the Royal Anthropological Institute. In 1939 Irving Rouse found the manuscript in the British Museum, which led to its final publication. As Rouse says in his foreword, "It compares favorably with current publications on the Antilles. Indeed, this report foreshadows several current trends, presenting as it does the first detailed stratigraphic analysis in the Antilles, worked out 16 years prior to Rainey's pioneer stratigraphic research in Puerto Rico, and a thorough reconstruction of Palo Seco culture, antedating by a quarter of a century the present interest in ethnographic reconstruction."

Bullbrook had had previous archaeological experience in England and the Sudan, where he worked with Oric Bates, who will be remembered by the older members of the profession, and who wrote one of the best but almost forgotten general essays on archaeology, published in the August, 1911, number of the *Atlantic Monthly*. Bullbrook states that he learned much of his method from Bates. This method is described in detail; it involved a grid system and one-foot levels removed in sections, with meticulous notes and a specimen catalog. Since the midden seldom exceeded 3 feet in depth, such careful work was necessary to secure any stratification at all. The midden consisted of 2 recognizably distinct shell strata, determined by the relative frequencies of certain genera and the nature of the matrix. The strata were separated by an uncomformity marking abandonment of the locality, but not of sufficient duration to involve major culture change ascertainable by analysis of the collection. Most of the sherds are of the Palo Seco style, with decoration, mainly on the flanges, consisting of broad-line incision and red painting, and modeled adornos. There is some white-on-red painting, but that combination was rapidly losing favor at this period and was confined to the lower level. A few sherds of the preceding Cedros style were found in the lowest levels, and a few of the succeeding Erin style in the topmost levels. The mound thus provides a good sample of Palo Seco material.

Following his descriptive section, Bullbrook devotes 17 pages to the history of the midden and the culture of its builders. In this he uses all the available ethnographic accounts and a great deal of sound reasoning, extracting about all that could be safely deduced from the data. There are also some observations on the skeletons found in several burials, and a short appendix on the geological relations of Trinidadian middens. The descriptive part of the report will be useful chiefly to specialists, but the cultural analysis will be of broader interest and should be of help for teachers who wish to illustrate what can be gained from relatively sparse materials. Rouse's appendix is helpful to the reader unacquainted with recent developments in Trinidadian archaeology. He summarizes the sequence of cultures and styles in the island, from nonceramic to historic times. This is introductory to a fully annotated list of known sites, accompanied by a map.

The monograph as a whole is a major contribution to Antillean archaeology. Amateur archaeologists everywhere can well take pride in this achievement by one of their fellows.

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CORRECTION

In the article by A. H. Gayton, "A New Type of Peruvian Shirt," Vol. 20, No. 3, the caption of Figure 76 should read: "The Ferdon shirt, from Piedras Gordas, Peru . . ." instead of ". . . from the Rimac Valley . . ."

NOTES AND NEWS

GENERAL

A conference on the use of radiocarbon for dating events of the late Pleistocene and Recent was held in October at Phillips Academy, Andover, Massachusetts, sponsored by the National Research Council, under a grant from the National Science Foundation. The chairman was Frederick Johnson, and those invited included specialists from physics, chemistry, geology, and paleontology, as well as archaeology.

The Society for American Archaeology has received from the Carnegie Corporation of New York a grant for $12,500 for a series of seminars to be devoted to analysis and interpretation of archaeological materials as they relate to broad cultural and historical subjects. It is estimated that 4 or 5 three-week seminars with an average of 6 participants can be held during the summer of 1955.

To consider and choose topics and to select chairmen of the seminars, the Executive Committee of the Society has appointed the following planning committee from the Society's membership: Jesse D. Jennings, Erik K. Reed, Albert C. Spaulding, Gordon R. Willey, and Robert Wauchope (ex officio chairman).

Each seminar chairman, when selected, will choose participants, and the time and place of meetings, in consultation with the above committee. The seminar chairman, with help from his seminar members, will be responsible for drawing up a plan and schedule of work, and later a report on the results. Participants will be reimbursed for travel and living expenses during the period of the meetings. It is expected that participants will do considerable preparatory work before the seminars actually begin. The seminar reports, whether written with separate contributions by individual participants or as longer papers written in collaboration, will, it is hoped, be published either in AMERICAN ANTIQUITY or in our MEMOIR series.

PACIFIC COAST

Charles E. Borden of the University of British Columbia reports that he is conducting a "teaching dig" at one of 2 recent sites on the Musqueam Reserve, Vancouver. This project is part of a course on the archaeology of British Columbia, which combines a treatment of facts and problems related to the prehistory of the Pacific Northwest with instruction in research technics.

Jim Baldwin, who has accompanied Borden on several field trips, has organized a small field party and is conducting a salvage excavation in the remaining portion of an originally large site on the outskirts of Prince Rupert, British Columbia. He reports considerable progress.

Douglas Osborne reports considerable archaeological activity at the University of Washington. Alan Bryan, with a small student crew, excavated 2 sites on Whidbey Island in Puget Sound for the State Parks and Recreation Commission. An in-the-field interpretive archaeological display is planned for one of the sites. Bryan will write his master's thesis on the results of this research.

Catherine McClellan and Osborne conducted a short survey at the end of the summer of the upper and middle Taku River areas of British Columbia and southeastern Alaska. A large power and industrial development will soon disturb the Taku and its tributaries. McClellan and Osborne feel that on the basis of their survey they now know the main site areas and will be able to give at least a comprehensive statement as to the next step in the archaeological exploration of the region.

James H. Gunnerson of the University of Utah has made a few short field trips since the close of the regular field season. One week-end trip with a group of students was made to the vicinity of Ferron, Utah, for the purpose of testing a deeply buried site which reportedly had yielded a fluted point. Gunnerson has been devoting most of his research time this fall to the processing and analyzing of material collected during the summer in excavations in southeastern Utah.

Your Assistant Editor received a copy of the annual report of the University of California Archaeological Survey. This document is impressive from the standpoint of what can be accomplished by such an organization. Through a system of interinstitutional cooperation under the centralized direction of Robert Heizer of the University of California, the survey is accomplishing a broad program of archaeological survey and excavation, publication, student training, public relations, and the collection of museum materials. As of June 30, 1954, the survey had in its records the location and an evaluation of 8122 archaeological sites. One can hope that it will be possible for similar programs to be established in other states.

William J. Wallace of the University of Southern California reports a salvage excavation program being conducted at a site in Long Beach in cooperation with Long Beach State College. The site, designated Los Altos 2, is about 400 yards north of the Los Altos site which produced a wide array of Canaliño-like artifacts 2 years ago. A somewhat different, perhaps slightly earlier, phase of occupation seems to be represented in the present site. He indicates that the work is being hampered by relic hunters who dig in the trenches at night by Coleman lanterns and car headlights. The work is being directed by graduate students from the University of Southern California — Peter Redwine, Jack C. Collins, Robert Hammond, and James Bogart — with most of the personnel coming from Long Beach State College.

Ruth D. Simpson informs us that the Southern California Archaeological Survey Association is conducting an active winter program. Excavations are being carried on at a burial site in Angeles National Forest, and at a village site near Mohave, Kern County. Greatest activity is in the desert area where field crews are making a survey of dry-lake terraces and stream channels. This

is a long-range program, but that progress is being made is indicated by reports of sites containing early dart-point complexes and complexes which lack projectile points entirely. A survey of petroglyph sites is being made, and a series of reproductions is being painted by Charles LaMonk. These painting are being sent on loan to museums for exhibit purposes.

SOUTHWEST

ARIZONA. The Department of Anthropology at the University of Arizona during December excavated a site in the heart of modern Tucson. A lot being cleared for a parking area was known to have been the northeast corner of the adobe wall that once surrounded the presidio of Tucson. The exact location of the corner was not known and the Department was asked to ascertain this for the city. In excavating the wall a Hohokam pit house dating in the 900's was uncovered as well as other living areas and floors. Sherds covering a span of time from roughly the 500's up to modern glass and china were removed during the course of excavation. At the moment the City of Tucson is considering making this area into a city park. It is particularly interesting that a large span of time with good stratigraphy was uncovered in a relatively small area.

The Amerind Foundation has recently completed and is moving into a large storage wing which will be used as the nuclear area of a study collection open to students of archaeology. New acquisitions to Amerind's Spanish historical materials are coming into the library and it is planned that the material will form a center for a historical research library with information particularly dealing with early Spanish contacts in southern Arizona and northern Mexico.

NEW MEXICO. The Chicago Natural History Museum expedition under Paul S. Martin and John B. Rinaldo, continued excavations during the past summer in the area around Reserve. The results now being analyzed may be summed up as follows: (1) further delineation of the Tularosa phase resulting from excavation of additional dwelling rooms and kivas from 3 Tularosa phase sites; (2) addition of 2 more stratified great kiva structures to those excavated in 1951-52 furnishing a local sequence of such structures from roughly A.D. 900 to 1250; (3) tentative delineation of a mealing bin-firepit-ventilator complex for smaller ceremonial structures as contrasted with the large roof posts, grooved floors, central hearth, and lateral ramp entrances of the larger structures.

TEXAS. The archaeological field school of Texas Technological College, Lubbock, sent 16 students into the field under the direction of Jane Holden, Earl Green, and W. C. Holden. They excavated portions of 8 sites in southeastern New Mexico during July and August. The purpose of the work was to obtain more information on the distribution of a sedentary agricultural people who lived in southeastern New Mexico in prehistoric times and who made frequent excursions into the sand hills of west Texas. Three rooms were excavated at the Bonnell site on the Ruidosa River, one of which had been burned. Two pueblo sites were tested on the Gallo River and one, an 11-room pueblo, was dug in cooperation with the Laboratory of Anthropology. The Bloom Mound on the Hondo River, 12 miles south of Roswell, had both a pit house and adobe pueblo rooms excavated. Two additional pit houses were excavated near Mayhill on the Penasco River. One was a pre-pueblo house dating prior to A.D. 700. A 16-foot circular pit house was excavated 2 miles north of the Gran Quivira. The floor was 5 feet below the present surface and the site dates between A.D. 700 and 900.

The Instituto Americano, Denton, Texas, announces that the *Interamerican*, its newsletter, will appear at least once each month, reporting on its activities. Also, the *Palimsest*, a mimeographed publication, will be issued as material is available dealing with the Southwest and Mexico, both original articles and translations from Latin American sources. Both will be sent to interested persons on request and without charge, although exchanges with other newsletters will be welcomed. Requests should be addressed to the director, Carl B. Compton, 5133 NT, Denton, Texas.

PLAINS

The 12th Plains Conference for Archaeology, with William T. Mulloy as chairman, was held at Lincoln, Nebraska, November 25-27, 1954. Donald J. Lehmer was elected chairman for the 13th Plains Conference to be held in 1955. Compared with previous conferences there were fewer field reports because of the curtailment of the Inter-Agency Archaeological Salvage Program in the Missouri Basin, a direct result of cuts in the federal budget. More formal papers were offered on a wide variety of subjects ranging from the geology of early man sites through ethnology to social problems arising from the displacement of modern populations in areas flooded by reservoirs.

Symposia attacking problems of interpretation in the archaeological record, so characteristic of many earlier conferences, were omitted. The taxonomic and chronological framework has been tentatively established for the Missouri Basin in North and South Dakota. Plains archaeology seems to be leveling off for another period of data gathering, this time to fill existing lacunae and test numerous hypotheses derived from recent work. As work progresses in the little known area of Oahe Reservoir more discussions of taxonomy and chronology will be needed. Discussion of the various contributions in this summary is limited to 3 projects furnishing data most pertinent to Plains archaeology.

Among the most important projects in the summer of 1954 was one in which the Smithsonian Institution and the State Historical Society of North Dakota, through an agreement with the National Park Service, cooperated in Garrison Reservoir, North Dakota. G. Hubert Smith led the Smithsonian group while Alan Woolworth, assisted by W. Raymond Wood, supervised the Historical Society party. At Like-A-Fishhook Village, occupied

jointly by the Arikara, Hidatsa, and Mandan, between 1845 and 1890, and by 2 forts, one a trading post and the other a military establishment in its later phase, the combined field parties carried on extensive salvage operations in the face of the steadily rising waters of the reservoir. Woolworth and Wood later carried on additional excavations at Grandmother's Lodge, a rectangular pit house attributed by the Mandan to the mythical Old-Woman-Who-Never-Dies, and at Kipp's Post, an establishment of the American Fur Company, 1825-1829. The filling of the Garrison Reservoir will prevent further work in the area.

In Oahe Reservoir Wesley R. Hurt, University of South Dakota, cooperated with the National Park Service in excavating part of the Swan Creek site, a rich, deep, earth-lodge village with 2 fortification ditches and an adjacent burial ground, about 20 miles south of Mobridge, South Dakota. Hurt has determined that the outer ditch is the later of the 2 and correlates with pottery of Stanley Braced Rim ware. The inner ditch correlates with pottery closely resembling that found in Mandan villages in North Dakota. A third ceramic variety at the site has not been correlated with structural features. It resembles that of the La Roche focus. The burials are divided into 2 types, flexed skeletons covered with wood in grave pits, and ossuary burials characterized by deposits of skulls separate from other bones. The flexed burials have dolichocranic skulls while the ossuary burials have skulls ranging from mesocranic to brachycranic. Both varieties have markedly sloping foreheads. No pottery has been found with the burials. A few copper ornaments occur in the ossuaries. Hurt will return to the site for a second season in 1955.

In Fort Randall Reservoir Marvin F. Kivett carried on excavations at the Crow Creek site between Chamberlain and Fort Thompson, South Dakota, for the Nebraska State Historical Society in cooperation with the National Park Service. The Crow Creek site has one of the most impressively bastioned and deeply ditched fortifications in the Missouri Basin and is characterized by deep deposits of refuse. Superimposed houses and their contents indicate at least 2 occupations, the older attributable to the Over focus of the Chamberlain aspect and the later one to some manifestation with Central Plains affinities. Kivett will spend a second season at this important site in 1955.

In 1955 the University of South Dakota, the Nebraska State Historical Society, and the University of Kansas will excavate under cooperative agreements with the National Park Service. The plans of the Smithsonian Institution are not formulated, pending budgetary allowances.

NORTHERN MISSISSIPPI VALLEY

ILLINOIS. The Hopewell burial mound partially excavated in the summer of 1954 by an Illinois State Museum archaeological field party was revisited during October, 1954, and further excavations carried out at the east edge of the mound. Seven more burials were found. Artifacts excavated with these burials included a falcon effigy pipe, conjoined copper tubes, turtle shell dish, shell spoons, shell beads, and split bear-canine beads. The most outstanding find of this recent excavation was a cache of rings made from cannel coal, pottery, and sandstone associated with one of the burials. These rings varied in size from 2 to 7 inches and had concave rims.

INDIANA. John C. Householder and Downey Raibourn continued excavation of a habitation site in Hamilton County.

OHIO. The Ohio Valley Archaeological Conference met in July at the Fort Hill excavations sponsored by the Ohio State Museum. A new publication series entitled *Papers in Archaeology* was inaugurated by the Ohio Archaeological and Historical Society with the publication of "Hopewellian Cremation Practices" by Raymond S. Baby.

MINNESOTA. A group of 6 students under the direction of Lloyd Wilford participated in the 1954 dig, much of the work being in the nature of salvage operations. Near Glenwood a state highway crew, having encountered skeletons in a gravel pit, discontinued operations until Wilford could study the area near the finds. Four additional burials were found. Pit 1 contained the secondary burial of an adult male and a projectile point, and pit 2 the skulls of an adult male and a young child, with associated red ocher. Pit 3 contained a primary infant burial with a large quantity of red ocher, a few shell beads, and small copper ornaments. Pit 4 contained the primary burials of a young adult male and a child. With the former were a tubular stone pipe, a stone bead, a crude knife, a shell ornament, and an object of antler.

At the Bryan site near Red Wing an acre of land had been stripped of topsoil and left by the highway crew for archaeological investigation. A total of 100 pits, nearly all primarily for storage, were found to contain charred corncobs, charcoal, and such refuse as animal bones and clam shells, together with a large quantity of potsherds and over 400 other artifacts. Chief among the latter were triangular arrowheads, knives, end scrapers, and bison-scapula hoes. The pottery comprised a mixture of Silvernale, Oneota, and some Cambria types. Of special interest were 3 house floors, the first found by Wilford in Minnesota. They were squarish and very small, about 8 feet on a side, and occupied shallow excavations in the gravel. One had a centrally located fireplace; another had been burned, leaving the floor covered with charcoal and charred thatch from the roof.

Near Deer River a 20-foot square in front of the previously studied mounds on White Oak Point was sifted for a pottery sample. While rich in sherds, the stratigraphy was disturbed by some 19th century Chippewa burials at a depth of 2 feet. Another test pit on the bank of Mud Lake near a large stand of wild rice exposed an almost solid mass of wood ashes and sherds, believed to mark the site of rice parching activity, antedating the introduction of the tin washtub.

Two large burial mounds in New Ulm and a third at nearby Swan Lake were excavated. One of the former, with a single layer of massed bundle burials on the floor of a shallow pit beneath the mound, is tentatively assigned to the Southern Minnesota Woodland aspect. The others had been too badly disturbed by the activities of white settlers and of burrowing animals to yield definite results.

MISSOURI. A considerable amount of archaeological work was initiated during 1954 in southwestern Missouri by members of the Ozarks Chapter of the Missouri Archaeological Society, Springfield. Proposed construction of a public water supply reservoir on the Little Sac River in Greene County led this group, under Harold J. Retallick, to conduct salvage surveys of the area to be inundated. Other construction in 1955 on the James River in southern Greene County will inundate about 7 miles of that stream. The Ozarks Chapter has already made preliminary plans, under the guidance of Retallick, H. Lee Hoover, and R. E. Haswell, for an extensive survey of this reservoir area.

Dr. and Mrs. Haswell, James and Henry Haswell, working under the auspices of the Ozarks Chapter, have completed an excavation of Griffin Rock Shelter in northeastern Dade County. Four occupational levels were found in the site, ranging apparently from Archaic to what may be a late marginal Plains group. A considerable amount of grit-tempered pottery with Hopewellian type decorations was found in the middle layers. A report on the Griffin Shelter is being prepared for the *Missouri Archaeologist*.

In the spring of 1954, members of the Ozarks Chapter joined with other members of the Missouri Archaeological Society and the University of Missouri in a survey of the upper reaches of the Norfork Reservoir in Ozark County. This reservoir, constructed during World War II, had never been surveyed, but an extreme drought in the Ozarks so lowered the water level that it was possible to visit a large number of sites previously under water. A number of Archaic sites, and one site of what appeared to be a Mississippian manifestation, were found in the Norfork area. Results of the Norfork survey will be published in the *Missouri Archaeologist*.

Ozarks Chapter president, Marvin E. Tong, Jr., worked during part of May with John O. Littleton of the National Park Service, in a historical survey of the Table Rock Reservoir on White River in Stone and Barry counties. They were able to locate the site of an early fur trading post operated by Joseph Philibert and William Gillis from about 1819 to 1830, and also found Philibert's burial place. This was the first information on trading activities on the upper White River. Scanty, but important information, was also found concerning sites of Delaware, Piankashaw, Miami, and Peoria groups that were along White River just prior to 1830.

Documentary evidence has recently been uncovered by Ozarks Chapter members that the present site of Yellville, Arkansas was a Shawnee village in 1819-1824.

NORTHEAST

The Narragansett Archaeological Society of Rhode Island is excavating a site in Apponaug, located on a protected sand terrace and containing a quantity of shell refuse. William S. Fowler, who is directing the research, reports that one season's efforts are very encouraging. It is felt that another season will be needed to conclude the work. So far, the site promises to provide valuable information concerning the various stages of pottery development and their associated lithic traits. This will be most helpful in organizing central New England materials.

Thomas E. Lee, National Museum of Canada, spent the fall of 1954 checking several features in the Rice Lake area of Ontario. He also examined the petroglyphs ground into crystalline rock near Peterborough, Ontario. He agrees with the members of the University of Toronto party which made extensive records of these that Laurentian type projectile points appear to be represented. Thus, their cultural provenience is suggested.

William Mayer-Oakes reports that the Upper Ohio Valley Archeological Survey will concentrate its efforts on the nature and content of the historic Monongahela culture in 1955. Plans are to work in conjunction with Waynesburg College in Greene County, Pennsylvania.

A new publication of interest to students of northeastern archaeology is being mimeographed and circulated by the New York State Archeological Association. This is called the *Bulletin*. Numbers 1 and 2 have already appeared.

SOUTHEAST

ALABAMA. The 11th annual Southeastern Archaeological Conference was held at Mound State Monument, Moundville, in October. David L. DeJarnette acted as host and a program of papers on the Southern Cult was arranged by W. G. Haag.

W. B. Jones initiated a surface survey of the Coosa River valley in the summer of 1954, in an area to be flooded by the Alabama Power Company dams. More than 100 sites were mapped and surface material collected. A project for excavation of key sites has been submitted to the power company.

Plans have been made for the excavation of the top level of Mound B at Moundville early in 1955, for the purpose of finding evidence that will permit restoration of the temple on the top level and the steps on the ramp.

FLORIDA. Ripley P. Bullen, Florida State Museum, spent November excavating the Barnhill Burial Mound between Boca Raton and Delray Beach. The mound, over 100 feet in diameter and 10 to 20 feet high, was built of white sand in a number of stages. About 100 poorly preserved burials were found in the excavated area, including the bundle, single skull, and extended types.

The St. Augustine Historical Society has planned a more intensive program of colonial and historical archaeology under the direction of John W. Griffin. A recent

excavation in the patio of the Oldest House revealed superimposed floors, the lowest dating from the 18th century, with majolica common beneath it.

An informal conference on pottery types of the Georgia-Florida frontier, especially historic forms, was held at the University of Florida, July 24 to 25. Participating were R. Bullen, J. and S. Caldwell, C. Fairbanks, J. and R. Goggin, J. W. Griffin, L. Larsen, and H. Smith. A large number of terms for stamped pottery of the early historic period were eliminated, the term San Marcos Stamped being retained for the style.

GEORGIA. Excavations at Etowah Mounds State Park under the auspices of the Georgia Historical Commission were continued by Lewis Larsen until early fall. All work in the 1954 season was in Mound C, partially excavated by Moorehead. Forty burials, most with Southern Cult furnishings, were found in the eastern part of the mound. Artifacts include a monolithic ax, copper headdress, copper celts, slate palettes, and shell gorgets with Eagle Warrior features. In several cases data on patterning of the large numbers of beads with burials were recoverable. The eastern side of the mound and parts of the northern and southern ends were rimmed with a post structure.

In Volume 20, Number 2 of this journal, on page 207, an editorial error attributed to the Wilbanks culture 2 marble statues and other cult material which actually pertain to Etowah IV or earlier Etowah levels.

The University of Georgia field school under the direction of A. R. Kelly excavated at Etowah in the small plaza adjacent to the western slope of Mound B. The midden exposed by Sears in 1953 was further uncovered and dug in a stratigraphic sequence from Lamar (early historic Cherokee) through Wilbanks to Etowah II-III. A rectangular house of the Wilbanks period was defined. The Etowah midden, beneath the Wilbanks level and separated from it by sterile red clay wash from Mound B, consisted of fill in a saucer-shaped depression with postmolds in its shoulder. Only a portion of the 2½-foot deep structure had been exposed in the 1948 season.

The periodical *Early Georgia* was scheduled to resume publication in December, 1954.

MISSISSIPPI. Robert Greengo, a Harvard graduate student, will continue digging through May in the Yazoo Basin, collecting material for a thesis on the northern and southern relationships of zoned rocker stamping.

OKLAHOMA. Robert E. Bell and a student group excavated for 8 weeks in the 1954 season at Lake Texoma. Collections were made from the 18 sites located. Excavations were conducted at 4 sites, ranging in time from the Archaic to the Fulton aspect.

VIRGINIA. John L. Cotter, assisted by Ed Jelks and L. R. Caywood, is working in the Jamestown area on a 3 year program designed to increase knowledge of the location and nature of buildings and artifacts associated with 17th century Jamestown, and to salvage everything in the path of construction scheduled for the 350th anniversary celebration in 1957. Work has been completed at Neck of Land opposite Jamestown Island, where links were established between the 17th and 19th centuries. Operations are under way in a previously uninvestigated tract south of Pitch and Tar Swamp, and will continue at other Jamestown Island sites, the Parkway, and Yorktown.

LOWLAND SOUTH AMERICA

Lowland South America is an area about which few archaeologists have any knowledge except that derived from the *Handbook of South American Indians*. However, many of the papers in these volumes were written almost a decade ago, when information was limited to what was brought back or described by people who were not only not archaeologists, but usually not even anthropologists. Almost nothing was known of the sites, and the cultures were represented by selected examples of decorated pottery. No chronological sequence had been worked out anywhere in this vast area. Consequently, when Steward was interpreting the origin, development and dispersal of Tropical Forest culture, he had to base his reconstructions on the ethnographic evidence.

Now, 10 years later, archaeological evidence has emerged from the work of a number of investigators: Cruxent in the upper Orinoco, Goethals on the coast of Dutch Guiana, Evans and Meggers in British Guiana and at the mouth of the Amazon, Hilbert on the Lower Amazon. All of these individuals have done stratigraphic excavations, permitting the establishment of local cultural sequences. In addition, sherd material collected from the Rio Branco, the lower Rio Negro and the upper Xingú gives clues to the situation in those regions. Since all of these results are unpublished and are likely to remain so for several years, a review of the major conclusions may be useful to those not intimately acquainted with the field.

One of the more expectable results of this work is the recognition of cultures with small sites and simple ceramics in addition to the elaborate pottery already known. In all of the areas thoroughly investigated, simple cultures are the predominant or the exclusive occupants. All the existing or reconstructible features duplicate those of the surviving cultures of the Tropical Forest area. The earliest do not differ from the latest in any manner suggestive of evolutionary elaboration or degeneration, although variation like that present on the ethnographic level is suggested by the archaeological remains.

Cultures with elaborate ceramics, formerly the only ones known from the area, have not been found except on the Amazon itself, and here they appear to be intrusive. This has been demonstrated stratigraphically only for the Marajoara culture on Marajó Island in the mouth of the Amazon, but ceramics recently recovered from sites along the river from Manaos eastward present features such as tall, conical tripod legs and flat pottery stamps with complex designs that strongly suggest influences from the areas of higher culture in western

and northwestern South America. Where the chronological position of these advanced, intrusive traits or cultures is known, it is late and overlies a series of simple cultures of the Tropical Forest type. It now appears that there were a number of presumably independent migrations or waves of diffusion from the high culture area in late pre-European times, and it is possible that some of these may be reflections of population disruption created by the expansion of the Inca Empire or the more general pressures resulting from population increase as cultural development reached a high level in the Andean and sub-Andean areas.

Where the complete archaeological sequences are known, in British Guiana and at the mouth of the Amazon, pottery-making cultures appear to be very recent introductions. In the absence of radiocarbon materials, the dates are estimates, but even allowing for several centuries of error, pottery-making cultures appear to date from not earlier than A.D. 500 at the mouth of the Amazon and considerably later in the Guianas. This situation, coupled with the absence of any affiliation of the earliest cultures with the known horizons in Venezuela, leads to the conclusion that Steward's reconstruction of the settlement of the Amazon by cultures which "spread from Venezuela down the Atlantic Coast and up the Amazon and its tributaries" (*Bur. Am. Ethn. Bull.* 143, Vol. 5, 1949, p. 762) is not borne out by the archaeological evidence. Nor does what is known of the archaeological situation in the upper Orinoco or the upper Essequibo suggest that any important introductions were made via these seemingly feasible inland waterways into the Amazon. On the contrary, all of the evidence to date points to migration and diffusion eastward and downstream from the headwaters of the western tributaries. If this is the case, the earliest archaeological remains from the western part of the Amazon basin should be of greater antiquity than those on the eastern margins. However, the prehistoric situation in this region is virtually unknown.

Even the small amount of archaeological field work carried out in the past decade has thus significantly altered the interpretation of prehistory in the Tropical Forest area. The next decade should see an acceleration of investigation in this area. The Museu Territorial in Macápa, Brazil, has appointed an anthropologist to the staff and placed facilities for archaeological field work at his disposal. The University of Paraná in Curitiba is in the process of inaugurating the first chair of archaeology in Brazil, and it will be possible for the first time to train Brazilian students in the scientific technics of field work and analysis. It is none too soon. The archaeology of lowland South America has lagged far behind that of almost every other New World area, and many significant questions have remained unanswered too long.

HIGHLAND SOUTH AMERICA

PERU. John Rowe has been doing extensive survey work in the area between Ayacucho, Andahuaylas, and Cuzco, finding sites in zones hitherto assumed to be barren. He is also doing research in ethnohistorical material. He is accompanied by Dwight Wallace and Dorothy Riddell of the University of California and by Chavez Ballón and Oscar Nuñez del Prado of the University of Cuzco.

From March until June, Dorothy and Fritz Riddell carried out reconnaissance and test cuts on the south coast from Taruga to Atico. Their principal focus of attention was the spread of the Nazca culture.

Alfred C. Kinsey of the Department of Zoology, University of Indiana, spent 4 weeks in Peru during August and September, studying erotic elements in pre-Columbian civilizations. He made photographic collections of this material in the museums of Chiclín, Magdalena Vieja, and in several private collections.

La Dirección de Arqueología y Historia made a series of test cuts in the Necropolis of Ancon, 250 meters west of Uhle's Site P. These cuts were for the purpose of determining the archaeological composition of this area before permitting the construction of a new access road to the beach. Although a number of interesting features of the Tiahuanacoid occupation on the coast were discovered, the general content of the cuts was not of such significance as to warrant impeding the proposed construction. This work was directed by José Casafranca in consultation with Louis Stumer.

Marino Gonzalez has continued the clearing of the Chavín de Huantar ruins, another project of the Dirección de Arqueología y Historia initiated early in 1954. He has found the "lanzón" to be only slightly damaged and has cleared it. The condor sculpture was also recovered, but since it had been covered by the river, the beautiful incisions have almost completely disappeared.

Stumer's excavations at Vista Alegre, Rimac valley, under the auspices of the Museum of the American Indian, continue apace. After having completed the excavation of previously rifled intrusive tombs in the secondary structures, he began excavations in the principal edifice. Present evidence indicates that it dates to the Maranga period. In clearing the building several new wares have been discovered. Noteworthy among these are a non-Chavinoid, fine-line, incised blackware and fine-lined, incised, orange and red ware. The motifs on these wares are similar to those on Playa Grande (Interlocking) wares of the Chancay and Chillon valleys.

CHILE. The Centro de Estudios Antropologicos of the University of Chile investigated several Incaic sites in the vicinity of Santiago. Students of the Centro completed research on a study of the archaeology of Chile from Arica to Santiago which is being assembled by Schaedel and will be published by the University of Chile. The excavations by Jorge Irribaren in Turquía, Hurtado valley, are also to be published in this study with an illustrative section by Francisco Cornely.

Louis Sandoval succeeded Schaedel as director of the Centro in December.

1954 VIKING FUND MEDALISTS

Archaeology

chosen by

The Society for American Archaeology

WILLIAM DUNCAN STRONG

General Anthropology

chosen by

The American Anthropological Association

ROBERT REDFIELD

Physical Anthropology

chosen by

American Association of Physical Anthropologists

WILLIAM WHITE HOWELLS

Award Citation

WILLIAM DUNCAN STRONG

As a major contributor to the theoretical structure of American archaeology and its interrelationships with other anthropological disciplines, William Duncan Strong is best known for his direct historic approach to the Great Plains and for his interpretations of the data from the Southwest, Subarctic, California, Middle American, and Andean areas. He is honored for the stimulation he has given to projects in these areas and others, for the breadth of his attainments, and for the outstanding students he has developed. His most recent major work is *Cultural Stratigraphy in the Viru Valley, Northern Peru.*

PREVIOUS VIKING MEDALISTS IN ARCHAEOLOGY

ALFRED VINCENT KIDDER, 1946
JOHN OTIS BREW, 1947
ALEX DONY KRIEGER, 1948
HALLAM LEONARD MOVIUS, JR., 1949
EMIL WALTER HAURY, 1950
FRANK HAROLD HANNA ROBERTS, JR., 1951
ALFONSO CASO, 1952
GORDON RANDOLPH WILLEY, 1953

INDEX OF VOLUME XX

Additional Information on the Bull Brook Site, Massachussetts, by Douglas S. Byers, 274
Aleutians, lamellar flake manufacturing site, 27
Allen, J. W. and C. H. McNutt, A Pit House Site Near Santa Ana Pueblo, New Mexico, 241
Anales de los Cakchiquels, see *Memorial de Tecpan-Atitlan (Solola)*
Análise Estalística de Cerâmica de Santarem, Uma, by Frederico Barata, reviewed by E. K. Reed, 300
Anangula Island, Aleutians, 27
Ancestor of Pottery?, by Agnes McClain Howard, 175
Annals of the Cakchiquels, The, trans. by Adrián Recinos and Delia Goetz, reviewed by Pedro Carrasco, 181
Annual Meeting of the Society for American Archaeology, 1954, 196
Antevs, Ernst, Geologic-climatic Dating in the West, 317
Archaeological Investigations in the Thule District. III, by Erik Holtved, reviewed by Deric O'Bryan, 397
Archaeology and Proteins, by Virginia Watson, 288
Archaeological Delineation of a Cultural Boundary in Papaguería, The, by Paul H. Ezell, 367
Archaeology of the Yale Reservoir, Lewis River, Washington, by Alan N. Bryan, 281
Archaeology of Wildrose Canyon, Death Valley National Monument, by William J. Wallace and Edith S. Taylor, 355
Archaeological Site in the High Sierra of California, An, by Donald Lathrap and Dick Shutler, Jr., 226
Arctic, Notes and News, 99, 305
Artificial Small Group Study and Archaeological Excavation, The, by Louis Dupree, 271
Aschmann, Homer, Comment on Quimby's "Cultural and Natural Areas Before Kroeber," 377
Asiatic flower-birds, 176
Attributes and the Discovery of Projectile Point Types: With Data from the Columbia-Fraser Region, by Marian W. Smith, 15

Baerreis, D. A., review of *Prehistoric Indians of Wisconsin*, by Robert E. Ritzenthaler, 399
Baggerly, Carmen, Waterworn and Glaciated Stone Tools from the Thumb District of Michigan, 171
Balser, Carlos, A Fertility Vase from the Old Line, Costa Rica, 384
Barnett, Frank and Willis H. Nelson, A Burial Cave on Kanaga Island, Aleutian Islands, 387
Bennett, Wendell C., *Excavations at Wari, Ayacucho, Peru*, reviewed by Alfred Kidder, II, 403
Barata, Frederico, *Uma Análise Estalística de Cerâmica de Santarem*, reviewed by E. K. Reed, 300
de Borhegyi, Stephan F., Chinese Figurines in Mesoamerica, 286; Comments on Incense Burners from Copan, Honduras, 284
Brainerd, G. W., review of *The Civilization of the Maya*, by J. Eric S. Thompson, 300; review of *Potsherds*, by Harold S. Colton, 187
Brief Survey of the Lower Colorado River, A, by Albert H. Schroeder, reviewed by H. S. Colton, 88
Brown, Gordon H., *Illustrated Skull Key to the Recent Land Mammals of Virginia*, reviewed by E. M. Reilly, Jr., 187
Bryan, Alan L., Archaeology of the Yale Reservoir, Lewis River, Washington, 281
Buettner-Janusch, John, Use of Infrared Photography in Archaeological Field Work, 84
Bullbrook, J. A., *On the Excavation of a Shell Mound at Palo Seco, Trinidad, B.W.I.*, reviewed by Alfred Kidder, II, 405
Burial Cave on Kanaga Island, Aleutian Islands, A, by Willis H. Nelson and Frank Barnett, 387
Burins from Central Alaska, by William Irving, 380
Byers, Douglas S., Additional Information on the Bull Brook Site, Massachusetts, 274

Caldwell, Joseph R., Cherokee Pottery from Northern Georgia, 277
Caldwell, Warren W., Two Cist Burials from San Juan Island, Washington, 383
California, pictographs, 68
California, site in the High Sierra, 226
California, southern, early milling stone cultures, 112
California, twined water bottles, 345
Carrasco, Pedro, review of *The Annals of the Cakchiquels*, trans. by Adrián Recinos and Delia Goetz, 181; review of *Title of the Lords or Totonicapán*, trans. by Dionisia José Chonay and Delia Goetz, 181
Carter, George F., "Disharmony between Asiatic Flowerbirds and American Bird-flowers," 176
Caso, Alfonso, *Interpretacion del Codice Gomez de Orozco*, reviewed by D. H. Kelley, 401; *El Pueblo del Sol*, reviewed by G. F. Ekholm, 401
Ceramic development, tradition trend in, 9
Chamberlain, Robert S., *The Conquest and Colonization of Honduras, 1502-1550*, reviewed by J. H. Rowe, 301
Chapman, K. M., review of *Kiva Mural Decorations at Awatovi and Kawaika-a*, by Watson Smith, 89
Chard, Chester S., An Early Pottery Site in the Chukchi Peninsula, 283
Cherokee Pottery from Northern Georgia, by Joseph R. Caldwell, 277
Chichen Itza: Architectural Notes and Plans, by Karl Ruppert, reviewed by Linton Satterthwaite, 190
Chinese Figurines in Mesoamerica, by Stephan F. de Borhegyi, 286
Chonay, Dionisia José and Delia Goetz (trans.), *Title of the Lords of Totonicapán*, reviewed by Pedro Carrasco, 181
Civilization of the Maya, The, by J. Eric S. Thompson, reviewed by G. W. Brainerd, 300
Coe, William R., II, Early Man in the Maya Area, 271
Collins, Henry B., The Position of Ipiutak in Eskimo Culture — Reply, 79

Colton, Harold S., *Field Methods in Archaeology*, reviewed by R. F. Heizer, 189; *Potsherds*, reviewed by G. W. Brainerd, 187; review of *A Brief Survey of the Lower Colorado River*, by Albert H. Schroeder, 88
Columbia-Frazer region, 15
Comment on Quimby's "Cultural and Natural Areas Before Kroeber," by Homer Aschmann, 377
Comment on the Windsor Site, Jamaica, A, by C. S. Cotter, 173
Comments on Incense Burners from Copan, Honduras, by Stephan F. de Borhegyi, 284
Comments on Rouse's Article on the Area Co-tradition, by Paul S. Martin, 160
Committee for the Recovery of Archaeological Remains, report of, 200
Conquest and Colonization of Honduras, 1502-1550, The, by Robert S. Chamberlain, reviewed by J. H. Rowe, 301
Constitution and By-Laws of the Society for American Archaeology, 192
Contributions to American Anthropology and History, Vol. XI, Nos. 52-56, reviewed by J. M. Longyear, III, 295
Correction on "Preclassic Metal?", A, by Robert E. Smith, 379
Co-tradition concept, 160
Co-tradition, Paleo-Indian, 64
Cotter, C. S., A Comment on the Windsor Site, Jamaica, 173
Cotter, John L., Indications of a Paleo-Indian Co-tradition for North America, 64; review of *The Jonathan Creek Village, Site 4, Marshall County, Kentucky*, by Wm. S. Webb, 182
Coville Rock Shelter, Inyo County, California, The, by Clement W. Meighan, reviewed by L. S. Cressman, 90
Cox, an Archaic Site in the Ozarks, by Marvin E. Tong, Jr., 124
Cressman, L. S., review of *The Coville Rock Shelter, Inyo County, California*, by Clement W. Meighan, 90
Cruciform Artifacts of the Sierra Occidental, by Agnes McClain Howard, 174
Cummings, Byron, obituary, 154

Dark, Philip, review of *A Study of Indian Beadwork of the North Central Plains*, 190
Dating archaeological sites, 51
Dating in the west, geologic-climatic, 317
Death Valley National Monument, 355
Denbigh Flint Complex is not yet Dated, The, by J. L. Giddings, Jr., 375
Dietz, Eugene F., Natural Burial of Artifacts, 273
"Disharmony between Asiatic Flower-birds and American Bird-flowers," by George F. Carter, 176
Dixon, Keith, A., review of *Workshop Notes*, Papers 1-8 (Textile Museum) 301
Drinking Tubes on Archaeological Vessels from Western South America, by Stig Rydén, 149
Dupree, Louis, The Artificial Small Group and Archaeological Excavation, 271

Early Man in the Eden Valley, by John H. Moss and others, reviewed by A. D. Krieger, 302
Early Man in the Maya Area, by William R. Coe, II, 271
Early Man, Notes and News, 305
Early Owasco Sequence in Eastern New York, An, by William A. Ritchie and others, reviewed by W. J. Mayer-Oakes, 292
Early Pottery Site in the Chukchi Peninsula, An, by Chester S. Chard, 283
Editor, Annual Report, 199
Ekholm, G. F., review of *Palenque, Una Ciudad Maya*, by Laurette Séjourné, 301; review of *El Pueblo del Sol*, by Alfonso Caso, 401
Ellis, F. H., review of *A Foundation for the Dating of Some Late Archaeological Sites in the Rio Grande Area*, by Terah I. Smiley and others, 292
Eskimo culture, Ipiutak in, 74, 79
Excavations at Kolomoki, Season III and IV, Mound D, by William H. Sears, reviewed by C. H. Fairbanks, 289
Excavation of Pindi Pueblo, New Mexico, The, by Stanley A. Stubbs and W. S. Stallings, reviewed by J. C. McGregor, 399
Excavations at the Polvo Site in Western Texas, by William J. Shackelford, 256
Excavations at Wari, Ayacucho, Peru, by Wendell C. Bennett, reviewed by Alfred Kidder, II, 403
Ezell, Paul H., The Archaeological Delineation of a Cultural Boundary in Papaguería, 367

Fairbanks, C. H., review of *Excavations at Kolomoki, Season III and IV, Mound D*, by William H. Sears, 289
Fenton, William N., *The Iroquois Eagle Dance*, reviewed by John Witthoft, 291
Fertility Vase from the Old Line, Costa Rica, A, by Carlos Balser, 384
Field Methods in Archaeology, by Harold S. Colton, reviewed by R. F. Heizer, 189
First Sheguiandah Expedition, Manitoulin Island, Ontario, The, by Thomas E. Lee, 101
Forged Tiahuanaco-style Keros, by John H. Rowe and Jimmy Guadagno, 392
Fort Massapeag [Long Island], 67
Fossil Bison and Associated Artifacts from Milnesand, New Mexico, by E. H. Sellards, 336
Foundation for the Dating of Some Late Archaeological Sites in the Rio Grande Area, A, by Terah I. Smiley and other, reviewed by F. H. Ellis, 292
Fowler, Melvin L., Some Fluted Projectile Points from Illinois, 170; Ware Groupings and Decorations of Woodland Ceramics in Illinois, 213
Frank Bay Site, Nipissing, Ontario, The, by Frank Ridley, 40

Gayton, A. H., A New Type of Ancient Peruvian Shirt, 263
Geologic-climatic Dating in the West, by Ernst Antevs, 317
Geological Approach to Dating Archaeological Sites, The, by Troy L. Péwé, 51

Gibson, Charles, *Tlaxcala in the Sixteenth Century*, reviewed by E. K. Reed, 400
Giddings, J. L., Jr., The Denbigh Flint Complex is not yet Dated, 375
Glass, Bryan P., *A Key to the Skulls of North American Mammals*, reviewed by E. M. Reilly, Jr., 187
Goetz, Delia and Dionisia José Chonay (trans.), *Title of the Lords of Totonicapán*, reviewed by Pedro Carrasco, 181
Goetz, Delia and Adrián Recinos (trans.), *The Annals of the Cakchiquels*, reviewed by Pedro Carrasco, 181
Graham Cave, an Archaic Site in . . . Missouri, by Wilfred D. Logan, reviewed by W. J. Mayer-Oakes, 185
Great Basin Archaeological Conference, 308
Greenman, E. F., Wave Action at George Lake 1, Ontario, 376
Gundagno, Jimmy and John H. Rowe, Forged Tiahuanaco-style Keros, 392

Haberland, Wolfgang, *Verteilung von Schmuckelementen im Bereiche der Klassischen Maya-Kultur*, reviewed by Tatiana Proskouriakoff, 402
Hargrave, Lyndon L. and H. Claiborne Lockett, *Woodchuck Cave, a Basketmaker II Site in Tsegi Canyon, Arizona*, reviewed by J. B. Rinaldo, 183
Heizer, R. F., review of *Field Methods in Archaeology*, by Harold S. Colton, 189
Highland South America, Notes and News, 315
"Historical Recollections" of Gaspar Antonio Chi, an Early Source-account of Ancient Yucatan, The, by M. Wells Jakeman, reviewed by J. E. S. Thompson, 189
Hodge Publication Fund, The Frederick Webb, 153
Holtved, Erik, *Archaeological Investigations in the Thule District, III*, reviewed by Deric O'Bryan, 397
Hooton, Earnest Albert, obituary, 158
Howard, Agnes McClain, Ancestor of Pottery?, 175; Cruciform Artifacts of the Sierra Occidental, 174
Hurt, Wesley R., The Randall Component, 280; *Report of the Investigation of the Thomas Riggs Site*, reviewed by R. P. Wheeler, 398

Illinois, fluted projectile points, 170
Illinois, Woodland ceramics, 213
Illustrated Skull Key to the Recent Land Mammals of Virginia, by Gordon H. Brown, reviewed by E. M. Reilly, Jr., 187
Indian Tribes of Aboriginal America, edited by Sol Tax, reviewed by Irving Rouse, 296
Indications of a Paleo-Indian Co-tradition for North America, by John L. Cotter, 64
Interpretacion del Codice Gomez de Orozco, by Alfonso Caso, reviewed by D. H. Kelley, 401
Ipiutak, position of, 74, 79
Iroquois Eagle Dance, The, by William N. Fenton, reviewed by John Witthoft, 291
Irrigation at Teotihuacán, by René F. Millon, 177
Irving, William, Burins from Central Alaska, 380

Jakeman, M. Wells, *The "Historical Recollections" of Gaspar Antonio Chi, an Early Source-account of Ancient Yucatan*, reviewed by J. E. S. Thompson, 189
Jamaica, Windsor site, 173
Johnson, Frederick, Report of the Committee for the Recovery of Archaeological Remains, 200
Jonathan Creek Village, Site 4, Marshall County, Kentucky, The, by Wm. S. Webb, reviewed by J. L. Cotter, 182
Judd, Neil M., obituary of Byron Cummings, 154

Kelley, D. H., review of *Interpretacion del Codice Gomez de Orozco*, by Alfonso Caso, 401
Key to the Skulls of North American Mammals, A, by Bryan P. Glass, reviewed by E. M. Reilly, Jr., 187
Kidd, Kenneth E., Trade Goods Research Techniques, 1
Kidder, Alfred, II, review of *Excavations at Wari, Ayacucho, Peru*, by Wendell C. Bennett, 403; review of *On the Excavation of a Shell Mound at Palo Seco, Trinidad, B.W.I.*, by J. A. Bullbrook, 405
Kiva Mural Decorations at Awatovi and Kawaika-a, by Watson Smith, reviewed by K. M. Chapman, 89
Krieger, A. D., review of *Early Man in the Eden Valley*, by John H. Moss and others, 302
Kroeber, A. L., Quantitative Analyses of Ancient Peruvian Metal, 160; *Paracas Cavernas and Chavín*, reviewed by G. R. Willey, 184
Kulp, J. L., review of *Radiocarbon Dating*, by Willard F. Libby, 88
Kurze Formen-und Begriffssystematik der Hieroglyphen der Mayahandschriften, by Günter Zimmermann, reviewed by J. E. S. Thompson, 189

Lamellar Flake Manufacturing Site on Anangula Island in The Aleutians, The, by William S. Laughlin and Gordon H. Marsh, 27
Lamellar Flakes versus Blades, a Reappraisal, by Ralph S. Solecki, 393
Larsen, Helge, The Position of Ipiutak in Eskimo Culture, 74
Lathrap, Donald W. and Dick Shutler, Jr., An Archaeological Site in the High Sierra of California, 226
Laughlin, William S., obituary of Earnest Albert Hooton, 158
Laughlin, William S. and Gordon H. Marsh, The Lamellar Flake Manufacturing Site on Anangula Island in The Aleutians, 27
Lee, Thomas E., The First Sheguiandah Expedition, Manitoulin Island, Ontario, 101
Libby, Willard F., *Radiocarbon Dating*, reveiwed by J. L. Kulp, 88
Little Sycamore Site and the Early Milling Stone Cultures of Southern California, The, by William James Wallace, 112
Lockett, H. Claiborne and Lyndon L. Hargrave, *Woodchuck Cave, a Basketmaker II Site in Tsegi Canyon, Arizona*, reviewed by J. B. Rinaldo, 183
Logan, W. D., *Graham Cave, an Archaic Site in . . . Missouri*, reviewed by W. J. Mayer-Oakes, 185

Longyear, J. M., III, review of *Contributions to American Anthropology and History*, Vol. XI, Nos. 52-56, 295
Lowland South America, Notes and News, 316

Man, Time, and Fossils, by Ruth Moore, reviewed by W. A. Ritchie, 185
Marsh, Gordon H. and William S. Laughlin, The Lamellar Flake Manufacturing Site on Anangula Island in The Aleutians, 27
Martin, Paul S., Comments on Rouse's Article on the Area Co-tradition, 160
Mayer-Oakes, W. J., review of *An Early Owasco Sequence in Eastern New York*, by William A. Ritchie and others, 292; review of *Graham Cave, an Archaic Site in . . . Missouri*, by Wilfred D. Logan, 185
McGregor, J. C., review of *The Excavation of Pindi Pueblo, New Mexico*, by Stanley A. Stubbs and W. S. Stallings, 399
McNutt, C. H. and J. W. Allen, A Pit House Site near Santa Ana Pueblo, New Mexico, 241
Medellin Zenil, Alfonso and Frederick A. Peterson, A Smiling Head Complex from Central Veracruz, Mexico, 162
Meighan, Clement W., *The Coville Rock Shelter, Inyo County, California*, reviewed by L. S. Cressman, 90
Memorial de Tecpan-Atitlan (Solola), ed. by Ernst Mengin, reviewed by Linton Satterthwaite, 181
Mengin, Ernst (ed.), *Memorial de Tecpan-Atitlan (Solola)*, reviewed by Linton Satterthwaite, 181
Metal, preclassic?, 64
Mexico, clay-grass bowl, 175; cruciform artifacts of the Sierra Occidental, 174; irrigation at Teotihuacán, 177; a new type of Archaic ruins in Chiapas, 62; smiling head complex, Veracruz, 162
Michigan, waterworn and glaciated stone tools, 171
Middle America, Notes and News, 207, 315
Millon, René F., Irrigation at Teotihuacán, 177
Mohr, Albert and L. L. Sample. Twined Water Bottles of the Cuyama Area, Southern California, 345
Moore, Ruth, *Man, Time, and Fossils*, reviewed by W. A. Ritchie, 185
Moss, John H. and others, *Early Man in the Eden Valley*, reviewed by A. D. Krieger, 302
Morgan, Richard G., *Outline of Cultures in the Ohio Region*, reviewed by A. C. Spaulding, 289

Natural Burial of Artifacts, by Eugene F. Dietz, 273
Nelson, Willis H. and Frank Barnett, A Burial Cave on Kanaga Island, Aleutian Islands, 387
New Mexico, fossil bison and associated artifacts, 336; pit house site near Santa Ana Pueblo, 241
New Type of Ancient Peruvian Shirt,A, by A. H. Gayton, 263
New Type of Archaic Ruins in Chiapas, Mexico, A, by S. Robert Russell, 62
Northeast, Notes and News, 206, 314, 409
Northern Mississippi Valley, Notes and News, 93, 313, 408
Note on Fort Massapeag [Long Island], A, by Carlyle S. Smith, 67
Notes and News, 92, 203, 305, 406

O'Bryan, Deric, review of *Archaeological Investigations in the Thule District*. III, by Erik Holtved, 397
Old Copper Assemblage and Extinct Animals, The, by George I. Quimby, 169
On the Excavation of a Shell Mound at Palo Seco, Trinidad, B.W.I., by J. A. Bullbrook, reviewed by Alfred Kidder, II, 405
Ontario, the First Sheguiandah Expedition, Manitoulin Island, 101; the Frank Bay site, 40
Outline of Cultures in the Ohio Region, by Richard G. Morgan, reviewed by A. C. Spaulding, 289
Ozarks, archaic site, 124

Pacific Coast, Notes and News, 95, 203, 306, 406
Palenque, Una Ciudad Maya, by Laurette Séjourné, reviewed by G. F. Ekholm, 301
Paleo-Indian co-tradition, 64
Papagueria, 367
Paracas Cavernas and Chavín, by A. L. Kroeber, reviewed by G. R. Willey, 184
Peru, analyses of ancient metal, 160; ancient shirt, 263; Rimac Valley, 130
Peterson, Frederick A. and Alfonso Medellin Zenil, A Smiling Head Complex from Central Veracruz, Mexico, 162
Péwé, Troy L., *The Geological Approach to Dating Archaeological Sites*, 51
Photography, infrared, 84
Physical anthropology, 72
Pictographs of the San Luis Rey Basin, California, by D. L. True, 68
Pit House Site near Santa Ana Pueblo, New Mexico, A, by J. W. Allen and C. H. McNutt, 241
Plains, Notes and News, 92, 205, 407
Population Centers of the Rimac Valley of Peru, by Louis M. Stumer, 130
Position of Ipiutak in Eskimo Culture, The, by Helge Larsen, 74; Reply, by Henry B. Collins, 79
Potsherds, by Harold S. Colton, reviewed by G. W. Brainerd, 187
Preclassic Metal?, by John L. Sorenson, 64
Prehistoric Indians of Wisconsin, by Robert E. Ritzenthaler, reviewed by D. A. Baerreis, 399
Prehistoric Settlement Patterns in the Virú Valley, Perú, by Gordon R. Willey, reviewed by Robert Stigler, 297
Projectile point types, discovery of, 15
Proskouriakoff, Tatiana, review of *Verteilung von Schmuckelementen im Bereiche der Klassischen Maya-Kultur*, by Wolfgang Haberland, 402
Publications on American Indian Physical Anthropology, 1952-53, by Erik K. Reed, 72
Pueblo del Sol, El, by Alfonso Caso, reviewed by G. F. Ekholm, 401

Quantitative Analyses of Ancient Peruvian Metal, by A. L. Kroeber, 160
Quimby, George I., The Old Copper Assemblage and Extinct Animals, 169; Reply to Aschmann's Comment, 378

Rachlin, Carol K., The Rubber Mold Technic for the Study of Textile-impressed Pottery, 394
Radiocarbon Dating, by Willard F. Libby, reviewed by J. L. Kulp, 88
Randall Component, The, by Wesley R. Hurt, 280
Recinos, Adrián and Delia Goetz (trans.), *The Annals of the Cakchiquels*, reviewed by Pedro Carrasco, 181
Reed, Erik K., Publications on American Indian Physical Anthropology, 1952-53, 72; review of *Una Análise Estalística de Cerâmica de Santarem*, by Frederico Barata, 300; review of *Tlaxcala in the Sixteenth Century*, by Charles Gibson, 400
Reilly, E. M., Jr., review of *Illustrated Skull Key to the recent Land Mammals of Virginia*, by Gordon H. Brown, 187; review of *A Key to the Skulls of North American Mammals*, by Bryan P. Glass, 187
Reply to Aschmann's Comment, by George I. Quimby, 378
Report of the Investigation of the Thomas Riggs Site, by Wesley R. Hurt, Jr., reviewed by R. P. Wheeler, 398
Revista Colombiana de Antropología, Segunda Época, reviewed by J. H. Rowe, 300
Ridley, Frank, The Frank Bay Site, Lake Nipissing, Ontario, 40
Rinaldo, J. B., review of *Salvage Archaeology in the Chama Valley, New Mexico*, assembled by Fred Wendorf, 294; review of *Woodchuck Cave, a Basketmaker II Site in Tsegi Canyon, Arizona*, by H. Claiborne Lockett and Lyndon L. Hargrave, 183
Ritchie, W. A., review of *Man, Time, and Fossils*, by Ruth Moore, 185
Ritchie, William A. and others, *An Early Owasco Sequence in Eastern New York*, reviewed by W. J. Mayer-Oakes, 292
Ritzenthaler, Robert E., *Prehistoric Indians of Wisconsin*, reviewed by D. A. Baerreis, 399
Rouse, Irving, review of *Indian Tribes of Aboriginal America*, edited by Sol Tax, 296
Rouse's article on the area co-tradition, comments by Paul S. Martin, 160
Rowe, J. H., review of *The Conquest and Colonization of Honduras, 1502-1550*, by Robert S. Chamberlain, 301; review of *Revista Colombiana de Antropología*, Segunda Época, 300
Rowe, John H. and Jimmy Guadagno, Forged Tiahuanaco-style Keros, 392
Rubber Mold Technic for the Study of Textile-impressed Pottery, The, by Carol K. Rachlin, 394
Ruins of Zaculeu, Guatemala, The, by Richard B. Woodbury and Aubrey S. Trik, reviewed by Robert Wauchope, 402
Ruppert, Karl, *Chichen Itza: Architectural Notes and Plans*, reviewed by Linton Satterthwaite, 190
Russell, S. Robert, A New Type of Archaic Ruins in Chiapas, Mexico, 62
Rydén, Stig, Drinking Tubes on Archaeological Vessels from Western South America, 149
Salvage Archaeology in the Chama Valley, New Mexico, assembled by Fred Wendorf, reviewed by J. B. Rinaldo, 294
Sample, L. L. and Albert Mohr, Twined Water Bottles of the Cuyama Area, Southern California, 345
Satterthwaite, Linton, review of *Chichen Itza: Architectural Notes and Plans*, by Karl Ruppert, 190; review of *Memorial de Tecpan — Atitlan (Solola)*, ed. by Ernst Mengin, 181
Schroeder, Albert H., *A Brief Survey of the Lower Colorado River*, reviewed by H. S. Colton, 88
Sears, William H., *Excavations at Kolomoki, Season III and IV, Mound D*, reviewed by C. H. Fairbanks, 289
Secretary, Annual Report, 197
Séjourné, Laurette, *Palenque, Una Ciudad Maya*, reviewed by G. F. Ekholm, 301
Sellards, E. H., Fossil Bison and Associated Artifacts from Milnesand, New Mexico, 336
Shackelford, William J., Excavations at the Polvo Site in Western Texas, 256
Shutler, Dick, Jr. and Donald W. Lathrap, An Archaeological Site in the High Sierra of California, 226
Smiley, Terah I. and others, *A Foundation for the Dating of Some Late Archaeological Sites in the Rio Grande Area*, reviewed by F. H. Ellis, 292
Smiling Head Complex from Central Veracruz, Mexico, A, by Alfonso Medellin Zenil and Frederick A. Peterson, 162
Smith, Carlyle S., A Note on Fort Massapeag [Long Island], 67
Smith, Marian W., Attributes and the Discovery of Projectile Point Types: With Data from the Columbia-Fraser Region, 15
Smith, Robert E., A Correction on "Preclassic Metal?", 379
Smith, Watson., *Kiva Mural Decorations at Awatovi and Kawaika-a*, reviewed by K. M. Chapman, 89
Solecki, Ralph S., Lamellar Flakes versus Blades, a Reappraisal, 393
Some Fluted Projectile Points from Illinois, by Melvin L. Fowler, 170
Sorenson, John L., Preclassic Metal?, 64
South America, Highland, Notes and News, 209, 411
South America, Lowland, Notes and News, 211, 410
South America, Notes and News, 97
South America, western, drinking tubes, 149
Southeast, Notes and News, 93, 206, 409
Southwest, Notes and News, 96, 204, 312, 407
Spaulding, A. C., review of *Outline of Cultures in the Ohio Region*, by Richard G. Morgan, 289
Stallings, W. S. and Stanley A. Stubbs, *The Excavation of Pindi Pueblo, New Mexico*, reviewed by J. C. McGregor, 399
Stigler, Robert, review of *Prehistoric Settlement Patterns in the Virú Valley, Perú*, by Gordon R. Willey, 297
Stubbs, Stanley A. and W. S. Stallings, *The Excavation of Pindi Pueblo, New Mexico*, reviewed by J. C. McGregor, 399

Study of Indian Beadwork of the North Central Plains, A, reviewed by Philip Dark, 190
Stumer, Louis M., Population Centers of the Rimac Valley of Peru, 130

Tax, Sol (ed.), Indian Tribes of Aboriginal America, reviewed by Irving Rouse, 296
Taylor, Edith S. and William J. Wallace, Archaeology of Wildrose Canyon, Death Valley National Manument, 355
Texas, western, Polvo site, 256
Thompson, J. Eric S., *The Civilization of the Maya*, reviewed by G. W. Brainerd, 300; review of *The "Historical Recollections" of Gaspar Antonio Chi, an Early Source-account of Ancient Yucatan*, by M. Wells Jakeman, 189; review of *Kurze Formen- und Begriffssystematik der Hieroglyphen der Mayahandschriften*, by Günter Zimmermann, 189
Title of the Lords of Totonicapán, trans. by Dionisio José Chonay and Delia Goetz, reviewed by Pedro Carrasco, 181
Tlaxcala in the Sixteenth Century, by Charles Gibson, reviewed by E. K. Reed, 400
Tong, Marvin E., Jr., Cox, an Archaic Site in the Ozarks, 124
Trade Goods Research Techniques, by Kenneth E. Kidd, 1
Tradition Trend in Ceramic Development, by Gordon R. Willey, 9
Treasurer, Annual Report, 198
Trik, Aubrey S. and Richard B. Woodbury, *The Ruins of Zaculeu, Guatemala*, reviewed by Robert Wauchope, 402
True, D. L., Pictographs of the San Luis Rey Basin, California, 68
Twined Water Bottles of the Cuyama Area, Southern California, by Albert Mohr and L. L. Sample, 345
Two Cist Burials from San Juan Island, Washington, by Warren W. Caldwell, 383
Typology, projectile point, 15

Use of Infrared Photography in Archaeological Field Work, by John Buettner-Janusch, 84

Verteilung von Schmuckelementen im Bereiche der Klassischen Maya-Kultur, by Wolfgang Haberland, reviewed by Tatiana Proskouriakoff, 402
Viking Fund Medalists for 1954, 412

Wallace, William James, The Little Sycamore Site and the Early Milling Stone Cultures of Southern California, 112
Wallace, William J. and Edith S. Taylor, Archaeology of Wildrose Canyon, Death Valley National Monument, 355
Ware Groupings and Decorations of Woodland Ceramics in Illinois, by Melvin L. Fowler, 213
Waterworn and Glaciated Stone Tools from the Thumb District of Michigan, by Carmen Baggerly, 171
Watson, Virginia, Archaeology and Proteins, 288
Wauchope, Robert, review of *The Ruins of Zaculeu, Guatemala*, by Richard B. Woodbury and Aubrey S. Trik, 402
Wave Action at George Lake I, Ontario, by E. F. Greenman, 376
Webb., Wm. S., *The Jonathan Creek Village, Site 4, Marshall County, Kentucky*, reviewed by J. L. Cotter, 182
Wendorf, Fred (assembler), *Salvage Archaeology in the Chama Valley, New Mexico*, reviewed by J. B. Rinaldo, 294
West Indies, Notes and News, 94
Wheeler, R. P., review of *Report of the Investigation of the Thomas Riggs Site*, by Wesley R. Hurt, Jr., 398
Willey, Gordon R., Tradition Trend in Ceramic Development, 9; *Prehistoric Settlement Patterns in the Virú Valley, Perú*, reviewed by Robert Stigler, 297; review of *Paracas Cavernas and Chavín*, by A. L. Kroeber, 184
Witthoft, John, review of *The Iroquois Eagle Dance*, by William N. Fenton, 291
Woodbury, Richard B. and Aubrey S. Trik, *The Ruins of Zaculeu, Guatemala*, reviewed by Robert Wauchope, 402
Woodchuck Cave, a Basketmaker II Site in Tsegi Canyon, by H. Claiborne Lockett and Lyndon L. Hargrave, reviewed by J. B. Rinaldo, 183
Workshop Notes, Papers 1-8 (Textile Museum), reviewed by K. A. Dixon, 301

Zimmermann, Günter, *Kurze Formen- und Begriffssystematik der Hieroglyphen der Mayahandschriften*, reviewed by J. E. S. Thompson, 189

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CONTENTS

		Page
Geologic-climatic Dating in the West	Ernst Antevs	317
Fossil Bison and Associated Artifacts from Milnesand, New Mexico	E. H. Sellards	336
Twined Water Bottles of the Cuyama Area, Southern California	Albert Mohr and L. L. Sample	345
Archaeology of Wildrose Canyon, Death Valley National Monument	William James Wallace and Edith S. Taylor	355
The Archaeological Delineation of a Cultural Boundary in Papaguería	Paul H. Ezell	367

FACTS AND COMMENTS

The Denbigh Flint Complex is not yet Dated	J. L. Giddings, Jr.	375
Wave Action at George Lake 1, Ontario	E. F. Greenman	376
Comment on Quimby's "Cultural and Natural Areas before Kroeber"	Homer Aschmann	377
Reply to Aschmann's Comment	George I. Quimby	378
A Correction on "Preclassic Metal?"	Robert E. Smith	379
Burins from Central Alaska	William Irving	380
Two Cist Burials from San Juan Island, Washington	Warren W. Caldwell	383
A Fertility Vase from the Old Line, Costa Rica	Carlos Balser	384
A Burial Cave on Kanaga Island, Aleutian Islands	Willis H. Nelson and Frank Barnett	387
Forged Tiahuanaco-style Keros	John H. Rowe and Jimmy Guadagno	392
Lamellar Flakes versus Blades, a Reappraisal	Ralph S. Solecki	393
The Rubber Mold Technic for the Study of Textile-impressed Pottery	Carol K. Rachlin	394

BOOK REVIEWS

Holtved: Archaeological Investigations in the Thule District, III	O'Bryan	397
Hurt: Report of the Investigation of the Thomas Riggs Site	Wheeler	398
Ritzenthaler: Prehistoric Indians of Wisconsin	Baerreis	399
Stubbs and Stallings: The Excavation of Pindi Pueblo	McGregor	399
Gibson: Tlaxcala in the Sixteenth Century	Reed	400
Caso: Interpretacion del Codice Gomex de Orozco	Kelley	401
Caso: El Pueblo del Sol	Ekholm	401
Haberland: Die regionale Verteilung von Schmuckelementen im Bereiche der Klassischen Maya-Kultur	Proskouriakoff	402
Woodbury and Trik: The Ruins of Zaculeu, Guatemala	Wauchope	402
Bennett: Excavations at Wari, Ayacucho, Peru	Kidder II	403
Bullbrook: On the Excavation of a Shell Mound at Palo Seco, Trinidad, B.W.I.	Kidder II	405
Notes and News		406
1954 Viking Fund Medalists		412

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